VOL. XII No. 3

MARCH 1927

MECCANO MAGAZINE

FLOATING PNEUMATIC GRAIN ELEVATORS

(See page 240)

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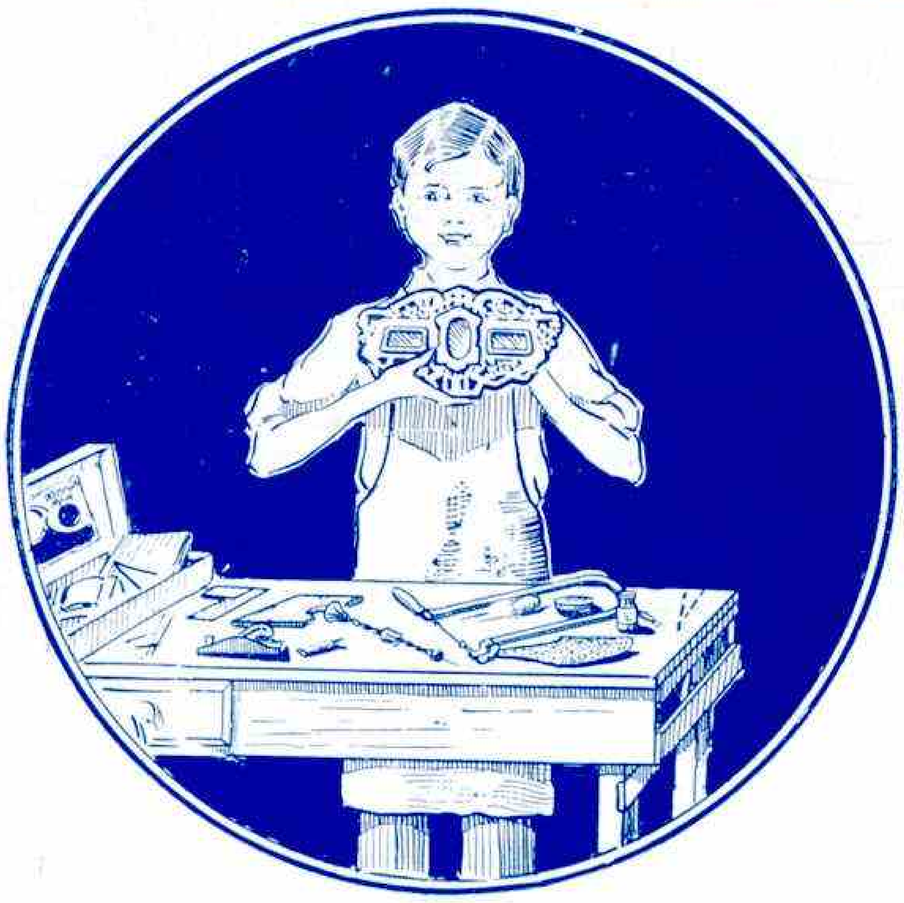
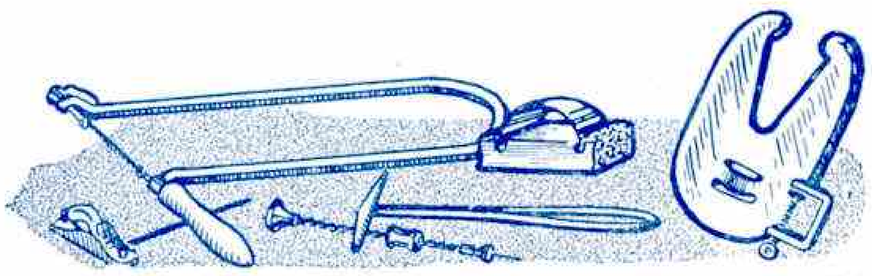


HOBBIES

HELP YOU TO HAPPINESS!

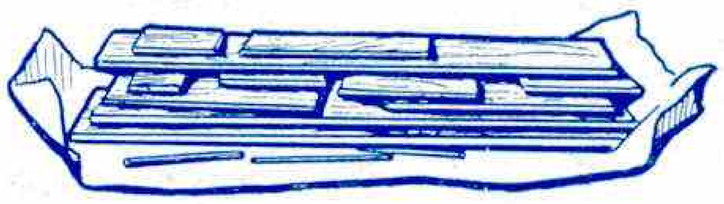
Read this short story of two boys who turned their spare time to profit.

In these days, no boy who really *is* a boy, is satisfied with playing marbles or spinning tops. He must do something helpful to him in after life; turn his hand to something useful in his spare time. We know of two brothers who since Christmas have earned quite a lot of pocket money by taking up



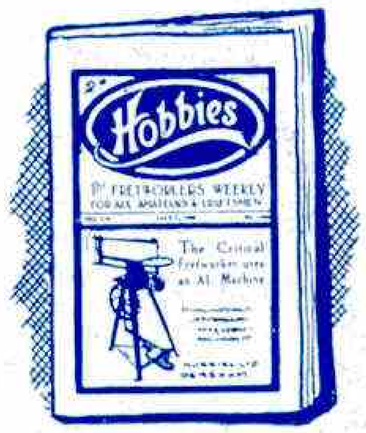
Fretwork. They saw a copy of Hobbies one week and now get it regularly from their newsagent; the cost of 2d. is more than repaid by the large fourpenny design given away. This design is for making something useful, and there are lots of other interesting subjects also dealt with in each issue. Photography, toy-making, pet-keeping, stamp collecting—all have a place.

They found, too, it was a delightful pastime making up cabinets, brackets, pipe-racks, handkerchief boxes, clocks, and a host of other things from the designs. Full instructions are provided and the question of the proper wood is overcome by the fact that a suitable parcel is always sold at a reasonable price in connection with these designs.



These parcels are procurable for almost any subject, and in the Hobbies 1927 Catalogue there are details and illustrations of over 500 splendid things to make.

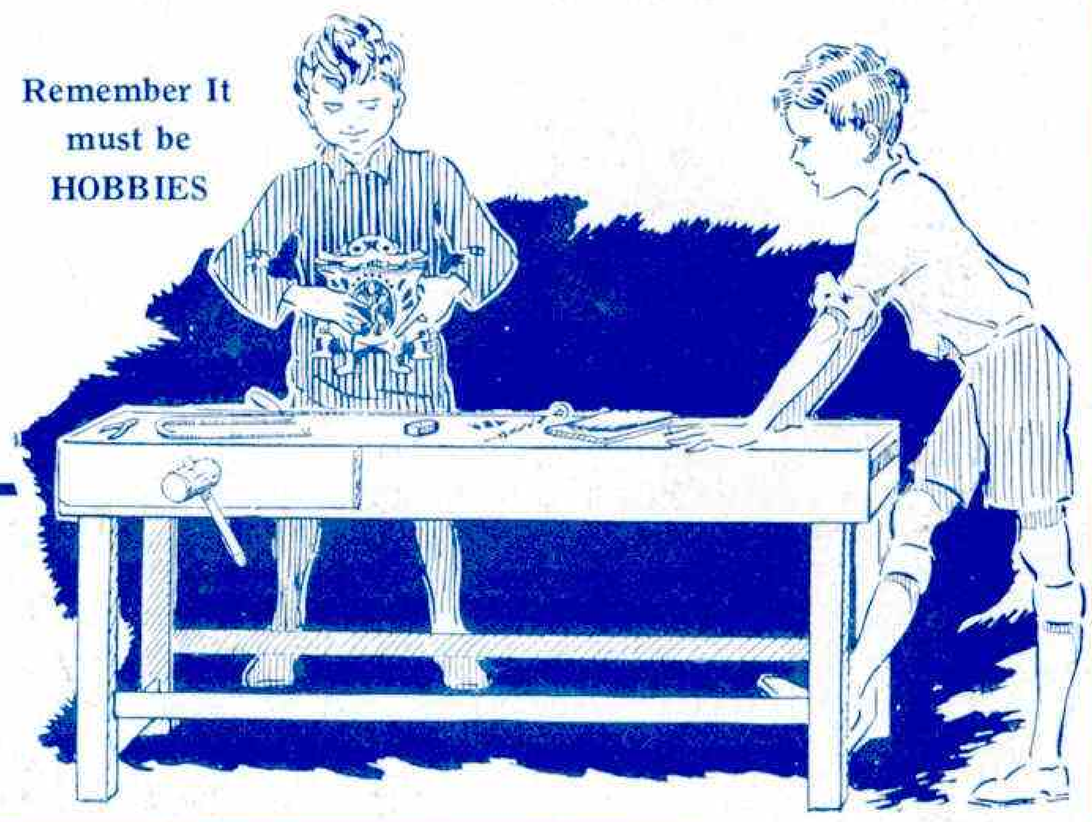
Of course, each of these boys had a Hobbies Fretwork Outfit, containing all the tools they required. There were, they found, Outfits at



all prices, and they add to their tool chest by additions from the Catalogue. These don't cost anything, really, because when they've made something—a beautiful Clock, or a useful Pipe Rack—they quickly sell it and so provide money to buy more. And it always provides enough pocket money for them to spend. The tools, of course, make a difference. If they had bought a cheap set with inferior German tools, they would not have lasted long, and would soon have needed replacing. So they insisted on a Hobbies Outfit, and now they are happy.

By the way, that 1927 Catalogue they bought is a wonderful affair. There are 248 pages with tools and materials for 20 different pastimes. In addition there are two large designs (worth 9d. each) for making a Ukulele and a Clock. These are free. The Catalogue they bought at the newsagents for 9d., but when another friend wanted one they were all gone. He got one, however, post free, by sending 1/- to Hobbies.

Remember It must be HOBBIES



Every Meccano Boy is sure to be interested, and we will send to anyone a specimen copy of HOBBIES and a Catalogue of these Outfits and Tools Write to-day to

Hobbies Ltd. (Dept. 196), Dereham, Norfolk

Or pay a call at any Hobbies Branch in London, Glasgow, Manchester, Birmingham, Sheffield, Leeds, Southampton or Brighton. Canadian readers write to 45, Colborne Street, Toronto.

MECCANO MAGAZINE

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With the Editor

Turbines Replace Oil Engines

Although oil seems to be coming into favour, it is evident that it will not be allowed to attain the position of "top-dog" without a stiff fight from supporters of the steam engine, and it is interesting to find that in more than one case there have been reversals of modern tendencies. One instance is furnished by the authorities at Bellefontaine, Ohio, who by substituting turbines for their Diesel engines have not only been able to reduce the charges for electric light and power by 50%, but have purchased another turbine out of profits even on the reduced charges. Prior to 1914 the city's current was provided by two 255 h.p. Diesel engines, driving 125 k.w. alternating current generators. Then a 300 k.w. three-stage turbine generator was installed, to be followed in 1922 by a 600 k.w. five-stage turbine. In the following year the charges both for light and power were reduced by approximately 20% and in 1924 further reductions were effected and a new five-stage turbine added to the plant.

Yet another instance of steam ousting oil is reported from Sweden. The steamer "*Italia*," owned by the Svinska Lloyd Line, is being refitted with a Lentz valve steam engine in place of the Diesel engine that previously propelled her, and it is stated that the Lentz valve engine at least will offer serious rivalry to the Diesel engine. It is evident that the future holds some interesting developments, in which no doubt readers of the "*M.M.*"—the engineers of the future—will play their part.

Will there be an Oil Famine?

A special Board of Investigation, appointed two years ago by the President of the United States to enquire into the oil resources of the country, recently issued its report. The Board, which consists of four members of the Cabinet, states that the crude oil reserves in the United States amount to 189,000 million gallons, or enough to last at the present rate of consumption for not more than six years. The Board expresses its fears as to what would happen should the country become dependent for its oil supplies on foreign nations, and urges that, in addition to a strict conservation of supplies, efforts should be directed towards the acquisition of all available foreign oil reserves.

The subject of the world's oil supplies is one that concerns this country, for a great part of our crude oil and petrol comes from the United States. Fortunately, however, we are by no means dependent upon America for our supplies, for although of the motor spirit imported in 1924 over 70% was received from the States, of our crude petroleum imports 82% were sent to us by Persia and of our refined fuel oil imports 64% were received from Mexico. Any famine of oil in the United States would thus clearly affect that country to a much greater degree than it would Great Britain.

A Race for Life

Everyone is interested in historic deeds of physical prowess, and of these there can be few more remarkable than the race run by John Colter against the Blackfeet Indians. Colter, a scout and trapper, was on a trapping expedition far up the Missouri, with a partner named Potts. Early one morning they were paddling silently up the river through a thick mist which suddenly lifted and disclosed, to their horror, the banks lined with Blackfeet Indians, who set up a great war-cry as soon as they observed the white men. The latter, realising it was impossible to escape, obeyed the Indians' command to come ashore.

As soon as the canoe touched the bank an Indian seized Potts' gun, but with great coolness Colter leaped ashore and snatching the gun from the Indian warrior, gave it back to Potts, who appears then to have lost his head, for he at once fired at one of the Indians on the bank. In quicker time than it takes to tell, Potts' body was pierced by innumerable arrows and Colter gave himself up for lost, knowing full well that the Blackfeet only knew one law—"a life for a life."

The Indians evidently admired Colter's brave front, however, and they held a council to decide how they should dispose of this brave man. They decided that he should provide the fun for a human chase, the greatest sport they knew and one that was even more exciting than a buffalo hunt, with the scalp of the white man as the prize to whichever brave could take it.

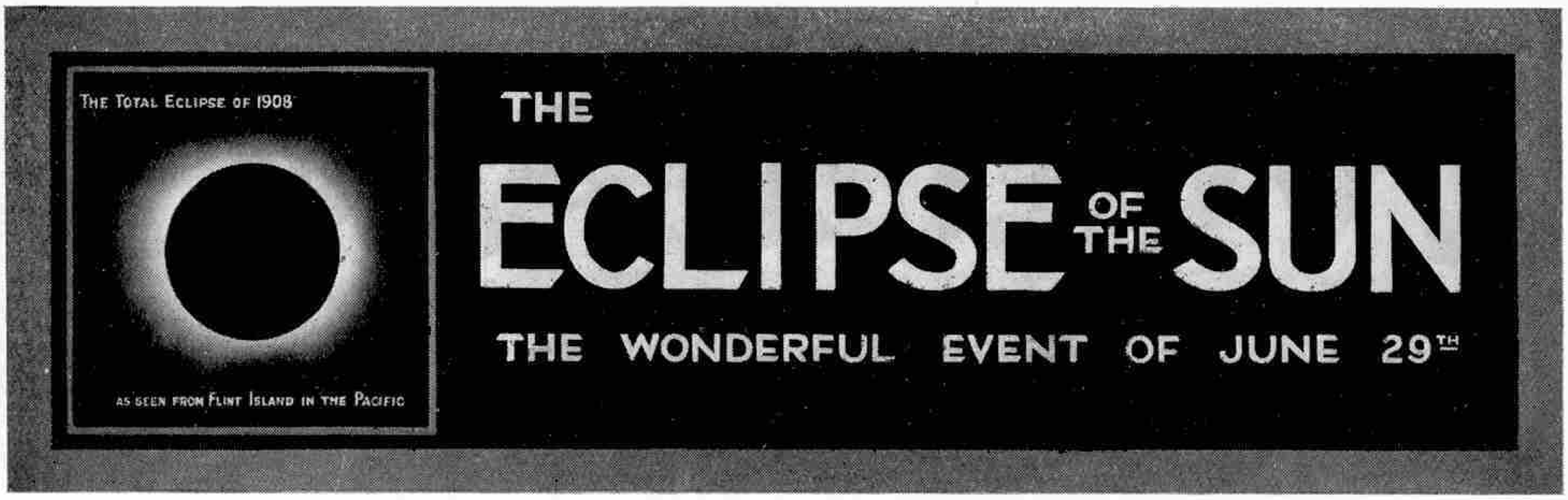
A Desperate Expedient

Colter was stripped naked and taken to a plain near the river. He did not mind the loss of his clothes, the absence of which would, if anything, rather help him in his race. The fact that he was bare-foot was a great handicap, however, for the plain was thick with prickly pears and at every step his feet would be torn by the thorns. Notwithstanding this, he showed no sign of fear, and although the chances were a thousand to one against him, he bravely determined he would put up a fight for his life. He stood on the prairie and at the distance of a spear throw behind him were lined up the finest athletes in the Blackfeet Tribe, who, at a given signal leaped toward their victim.

Colter was off like a hare at the first opportunity and, flying over the prairie, his feet cut to ribbons by the cactus and the rocks, he ran for six miles until the strain caused a blood vessel to burst in his head. Only then did he look round, to find that three of the Indians had managed to keep up with him. As he turned, one was on the point of throwing a spear, but Colter's unexpectedly ghastly appearance—his head and chest were covered with blood—caused the warrior to miss his step and he stumbled and fell. The trapper was on him instantly, and having pinned him to the ground with his own spear, was off again towards the river. Realising that his only chance was to hide, for he was rapidly losing strength, he reached the bank of a river, dived in and swam under a mass of drift-wood caught in mid-stream. Here he was concealed from view but at the same time was able to breathe beneath the logs.

Vindicated by the Indians

In a few minutes the banks of the river were crowded with his pursuers, but although they searched long and far they did not discover him. When darkness came Colter, more dead than alive after his long immersion in the icy water, drew himself up from the river and began a march to the nearest trading post. For seven days he travelled naked across the prairie and without food except for berries. He passed through the Bozeman Pass and the Yellowstone, ultimately arriving at Lisa's Fort at the mouth of Big Horn. Here nobody would believe his story, as they would not believe him on a previous occasion when he told of the great geysers of Yellowstone, of the hot springs, of the marvellous canyon and of the Obsidian Cliff. It was not until years afterwards that his name was vindicated when the Indians themselves told with admiration the story of the scout's brave spirit and equally wonderful exploit.



RATHER more than four thousand years ago a very tragic event happened at the court of Chung-K'ang, Emperor of China. The existence of a dragon that was in the habit of attempting to devour the Sun from time to time was well known, and one day consternation reigned when its claws were seen to be closing over that benevolent source of light and heat, and no preparations had been made to scare it away! Luckily, a hastily arranged demonstration with drums, trumpets, sticks, and yells, was successful in averting the threatened calamity, and then enquiries were made as to the cause of the omission of the two court astronomers to give due notice of the event.

Astronomers' Sad Fate!

These two mandarins, Ho and Hi, were found guilty of grave neglect of duty—they had, in fact, been enjoying a little private festivity—and then suffered the usual Chinese punishment of having their heads cut off!

A modern historian of eclipses has suggested that the sentence was excessive in view of the fact that the eclipse was only a partial one, which seems to be a suggestion that they would have been more appropriately punished by having their heads partially cut off instead of totally!

Another writer gives a different account of the end of the two unlucky astronomers in the following verse :—

Here lie the bodies of Ho and Hi,
Whose fate though sad was risible—
Being hanged because they could not spy
Th' eclipse that was invisible.

In this story we have one of the earliest accounts of an eclipse of the Sun. From that time, probably 2136 B.C., down to the present day, eclipses of the Sun have been continually observed and studied, so that now we are perfectly familiar with them as natural events and look forward to their occurrence.

The Coming Eclipse

It is well known, for instance, that an eclipse of the Sun, visible in England, will take place on 29th June next, and further that the light of the Sun will be completely cut off from a narrow strip of country extending from North Wales, across Lancashire and Yorkshire. Those of our readers who live on the path of totality, as this strip is called, should consider themselves very fortunate indeed to have the opportunity of seeing one of the most imposing of natural sights. The only exertion required is to rise at an early hour, as the actual eclipse happens just before half-past six in the morning; but the knowledge that such an event has not occurred in England for over 200 years, and will not occur again until the year 1999, should be sufficient to stir everybody into activity. If any reader should oversleep on 29th June he is cordially invited to the next eclipse in 1999, which occurs at the more suitable hour of 11 o'clock!

Next June the railway companies will run special excursion trains to Yorkshire and Lancashire, a practice commenced on the occasion of an interesting eclipse in 1858. Undoubtedly there will be a great influx of people to places at which the eclipse is total.

Total Eclipses Not Often Seen

In general there are nearly seventy total eclipses in a century, but they are so evenly spread over the surface of the earth that a stay-at-home individual who reaches the age of eighty will have been fortunate if he has seen one. This will depend very greatly on the position of his home, however, for if this had been in the Yellowstone National Park of North America, and had the time been about 50 years ago, he could have seen two total eclipses within twelve years, in 1878 and 1889.

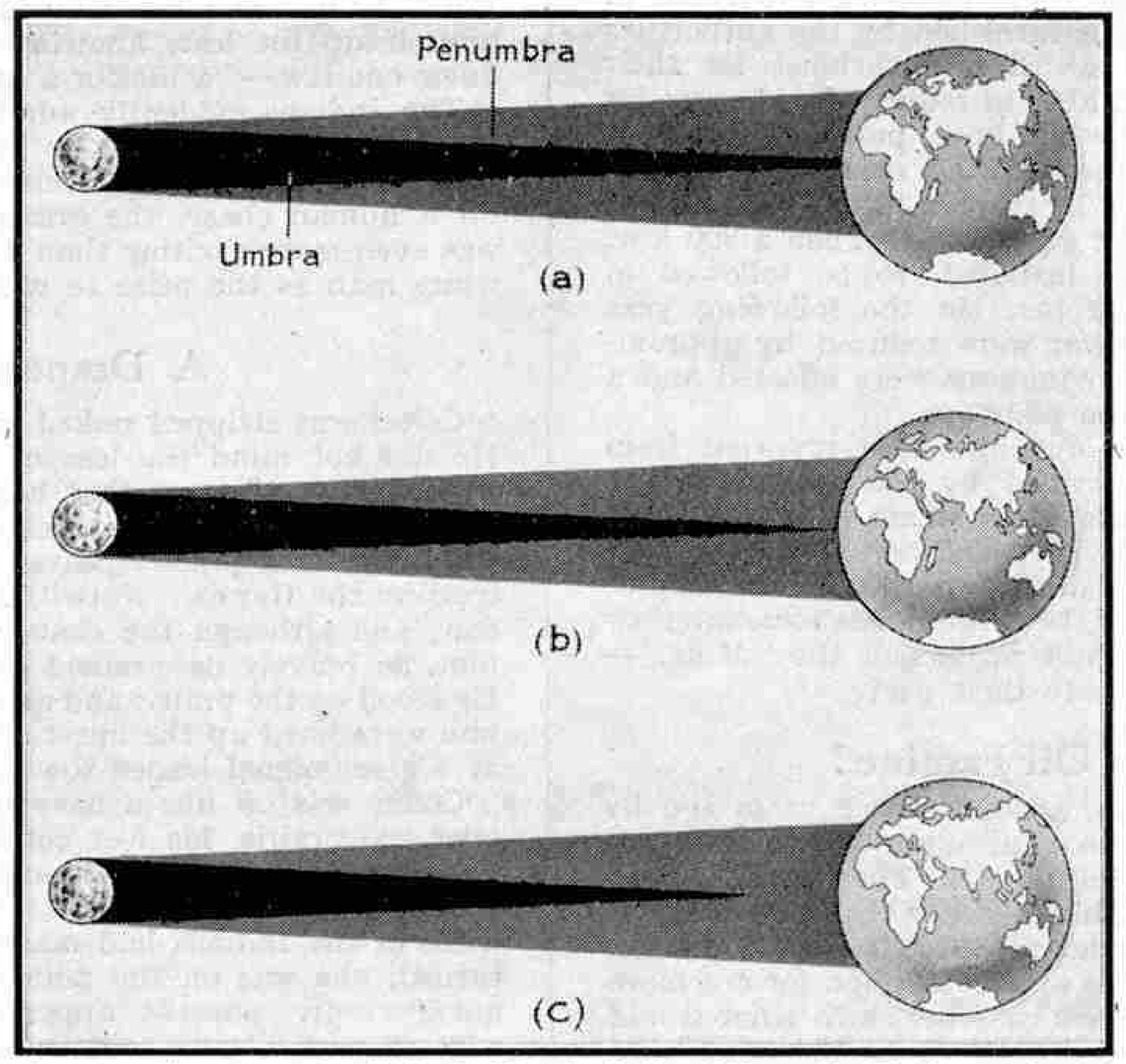


Fig. 1. Three ways in which the Moon's shadow falls on the Earth, causing (a) total eclipse (b) annular eclipse (total in centre of track) and (c) partial eclipse of the Sun

Anyone now living in London, where the last visible total eclipse occurred 212 years ago, will have been dead more than 400 years before such an opportunity again arises! This is on account of the fact that when the next total eclipse does occur in England (on the 11th of August,1999) the path of totality, will miss London and will very nearly miss England, too, as it just skirts the coast of Cornwall only in the extreme south. The rest of England and the whole of Scotland will only be the scene of a partial eclipse, so that for many centuries the inhabitants of the greater part of the area of Great Britain will have no opportunity of witnessing an eclipse without having to travel some distance.

As an example of the caprice of nature in these matters we may contrast the experiences of Spain and Scotland. In the latter country the last total eclipse was a very poor affair in Caithness in the extreme north in 1699, and the next will not occur until 2135—an interval of 436 years between successive total eclipses! But in Spain there were no fewer than five total eclipses between the years 1842 and 1905, or practically one in every twelve years.

The Best-observed Eclipse

Rather more than two years ago the Americans had a similar opportunity to the one now afforded us, when the totality track of the eclipse of 24th January, 1925, passed from Lake Superior to the Atlantic Coast, as shown on the map on the next page. So great was the interest aroused that over twenty million people congregated in positions where they could see for themselves what a total eclipse was like! Thus it was that the eclipse of January 1925 was easily the best observed eclipse on record.

The eclipse of this year will almost certainly arouse an equal interest in Great Britain, and we feel that our readers at all events will make every effort to see the eclipse in totality. So that the precious seconds during which the Sun is completely obscured will not be wasted, it is desirable to know something about eclipses, what to look for, etc., and it is with a view to satisfying these

demands that the present series of articles has been arranged.

How the Moon Eclipses the Sun

An eclipse of the Sun is well known to be caused by the Moon coming between the Sun and the Earth. This occurs every month, of course, but it is not so often that the Moon passes in a direct line between the Earth and the Sun. When this occurs an eclipse takes place. It seems strange at first sight that so tiny a body as our satellite can blot out a body so large as the Sun, but this is simply a matter of relative distance. A trial that can easily be made by readers will show that a 3d. piece held at arm's length will blot out the Moon in spite of the enormous difference in the size of the two objects.

This is the position that arises in the case of the Sun and the Moon. The diameter of the Sun is 400 times larger than the Moon, but fortunately it so happens that it is also 400 times further away from the Earth. Thus the two bodies, the Sun and the Moon, appear to be nearly equal, and the shadow of the Moon is therefore just about long enough to reach the Earth's surface.

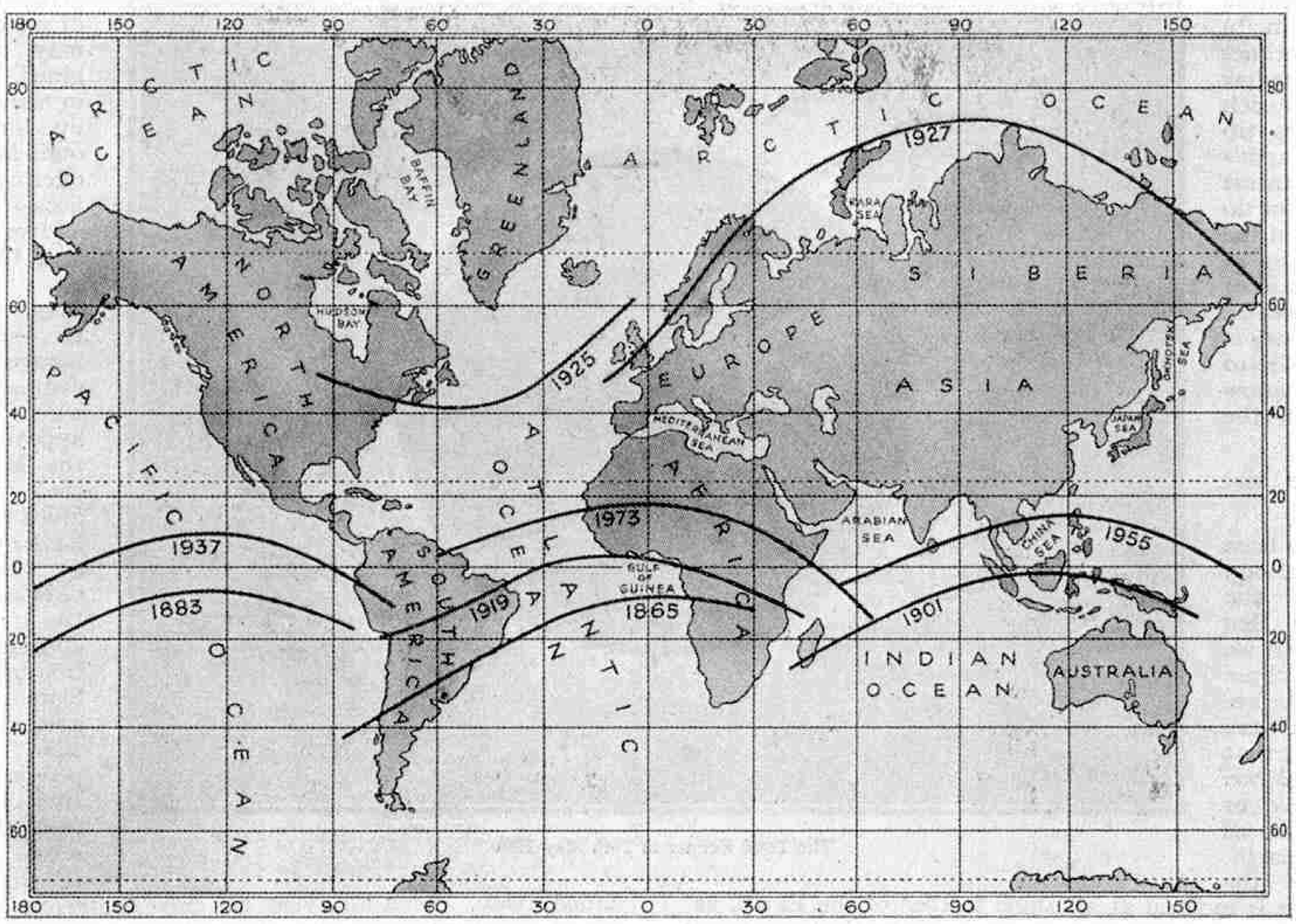


Fig. 2. Map of the World, on Mercator's projection, showing the tracks of some interesting total eclipses of the Sun

As the Sun is much larger than the Moon, the shadow is in two portions, the black central shadow, usually called the umbra, being surrounded by a larger half-shadow, or penumbra, spreading out into space. These two parts of a shadow can easily be seen and distinguished when a small ball is held between a source of light, larger than itself, such as a luminous gas mantle, and a sheet of white paper, and how they are produced in the case of the Sun and the Moon is illustrated by (a) Fig. 1.

Conditions for a Total Eclipse

It is only when an umbral shadow passes over a place on the Earth's surface that a total eclipse occurs, for some part of the Sun is always visible from places in which the penumbral shadow falls. In the case of the eclipse of 29th June next, Southport, Liverpool, and Durham fall within the umbral shadow of the Moon, and at these places the eclipse is total. Leeds, London, and Glasgow will be in the penumbral shadow, so that the eclipse in these cities will only be a partial one.

As the orbits of the Moon and the Earth are elliptical or oval in shape, the distances of the Sun and the Moon from the Earth and from each other vary by a few thousand miles, and this gives rise to interesting differences in the nature of eclipses.

If the three bodies come into line at the time when the Moon is at its least distance from the Sun and its greatest from the Earth, the tip of the central shadow will not reach the Earth, as shown in (c) Fig. 1. In this case the eclipse will only be a partial one, as the Sun will everywhere appear to be slightly larger than the Moon, but over one narrow track the appearance presented will be very striking, all that is visible of the Sun at the climax being a bright ring round the black disc of the Moon (c. Fig. 3). A good example of such an eclipse, which is said to be an annular one, was visible along a narrow track across England from Dorset to Lincolnshire in 1858. This eclipse has already been referred to as being the first for which special excursion trains were run.

In the case of a total eclipse the shadow is longer, and would reach to a point below the surface of the Earth, so that the Sun is obscured over a strip of the Earth's surface, which may be up to 170 miles in width and 8,000 miles in length.

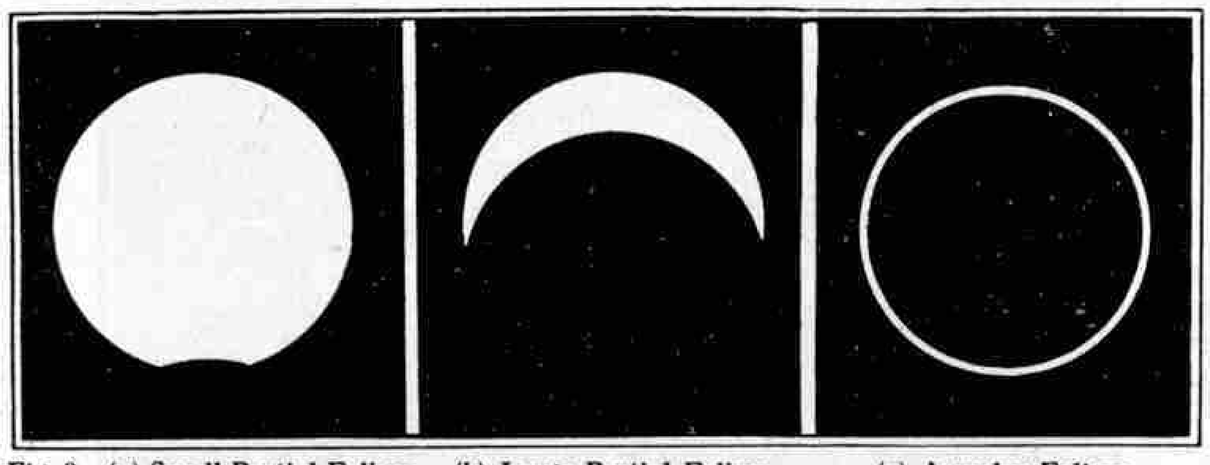


Fig. 3. (a) Small Partial Eclipse, 1908 (b) Large Partial Eclipse, 1912 (c) Annular Eclipse, 1858

An Astronomer on the Moon

These conditions obtain on 29th June next, and anyone wishing to carry out the Jules Verne plan of journeying to the Moon will certainly do well to defer his visit until that date, when he will be rewarded by an impressive sight. In order to see what happens on the Earth on that date he will have to establish himself on the dark side of the Moon. He will not be in total darkness, however, for in his sky will be the Earth, which will appear to him to be about fourteen times the size of the Moon as it appears to us on Earth, and it will shine with a beautiful silvery light, far surpassing that of fourteen full Moons in magnitude. As the Moon has no atmosphere, there are no air, dust, or water vapour particles to reflect either sunlight or earthlight, or to form clouds, and the sky always remains black. There will be nothing then, to prevent our Moon traveller from getting a splendid view of events on Earth. He will see the British Isles without optical aid, and if he has a telescope as good as those in the famous Yerkes or Lick observatories, such cities as London and New York will be easily visible to him, and he will even be able to distinguish the pyramids in the Egyptian desert.

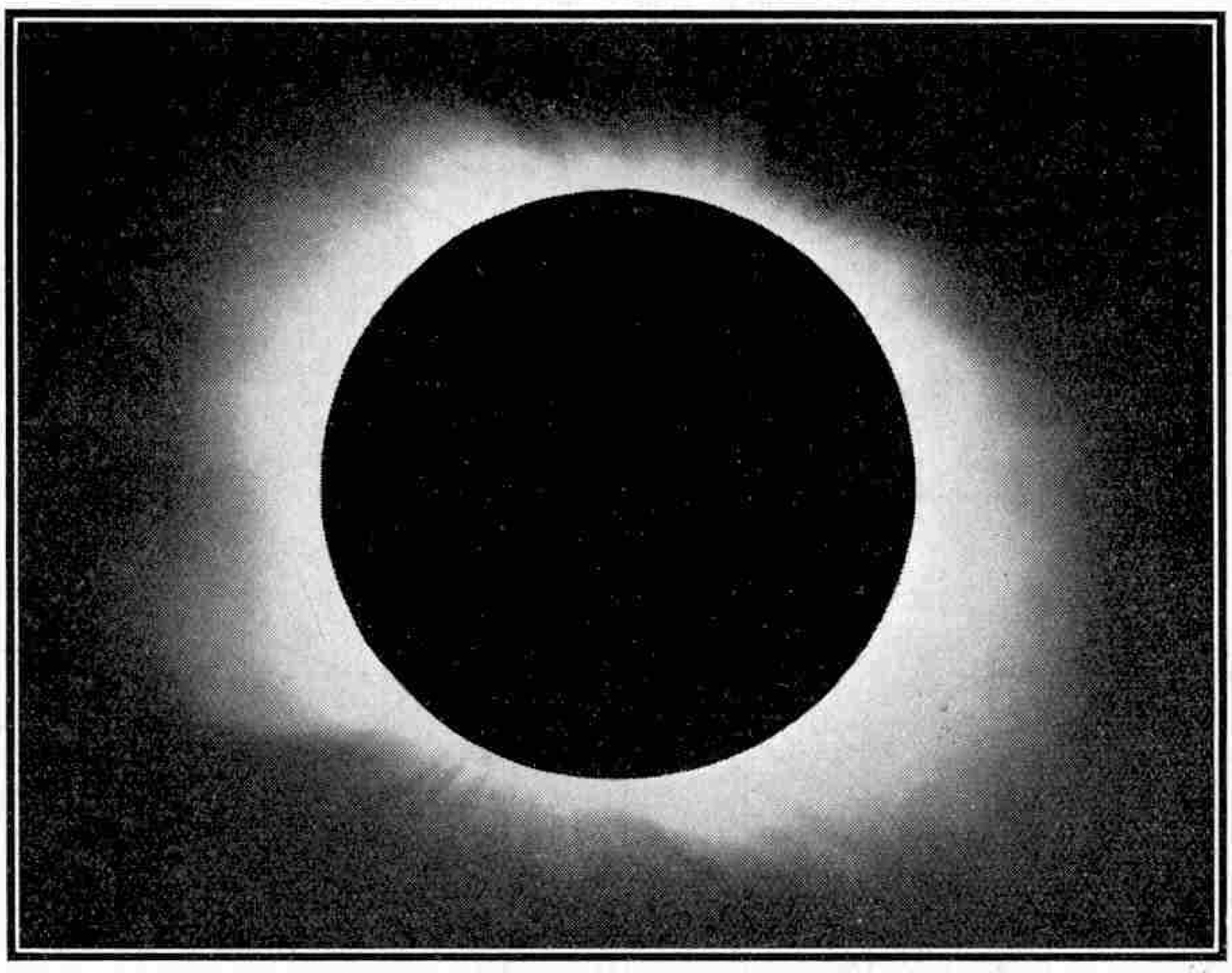
The Shadow on the Earth

It would be a considerable undertaking, though, to carry one of these telescopes to the Moon, so we will merely suppose that our voyager in space has taken a good portable one, and that with it he keeps careful watch on the morning of 29th June. At 4.0 a.m. he will see a shadow forming in Tripoli, in Northern Africa, which will grow rapidly until, about an hour and twenty minutes later, a smaller black umbral shadow almost circular in shape and nearly thirty miles across will form in its centre. This central shadow, first seen about 500 miles south-west of Lands End, will sweep across the surface of the Earth with a speed of over 1,000 miles an hour, and he will be able to follow it along its path—the path or track of totality—through the Arctic Ocean and the far north-east of Siberia to the spot near the Aleutian Islands, off the Alaskan coast, where it will pass off the Earth into space. The outer shadow will vanish more than an hour later in the Pacific Ocean to the south-east of Japan.

The size of this umbral shadow varies, and is greatest when the Moon is as near the Earth as possible and at its greatest distance

from the Sun. The greater the area covered by the shadow the greater is the time of totality at any one place, and thus the eclipses of longest duration occur in summer when the Earth is farthest from the Sun, the maximum being nearly eight minutes. The longest eclipses of all are those visible at the Equator at these times, as an observer at the Equator is carried along in the same direction as the shadow more quickly than if he were further north or south.

A very interesting case, illustrated in (b) Fig. 1, sometimes arises when the shadow of the Moon is of such a length that its tip just reaches the Earth's surface at the nearest point, but does not do so along the rest of the eclipse track owing to the curving away of the Earth's surface. In this case the eclipse is total in the middle of the track of the shadow and annular at the ends.



The Total Eclipse of 28th May 1900

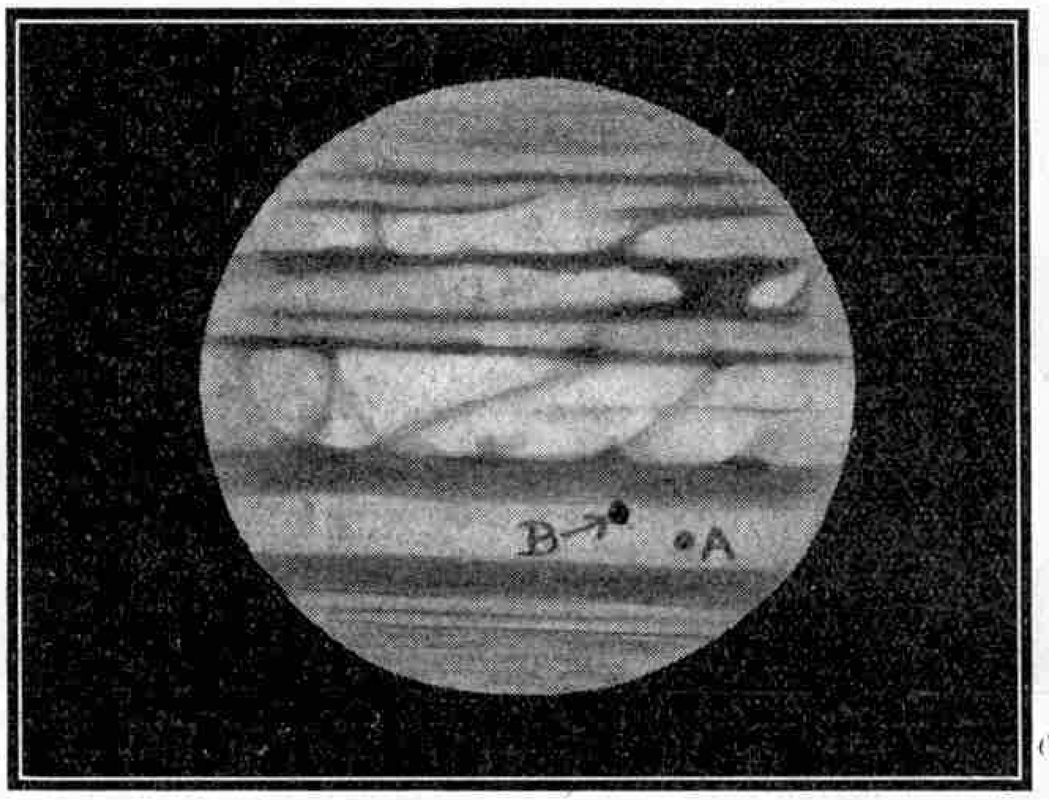
Why are there not more Eclipses ?

As has already been mentioned, the Moon passes between the Earth and the Sun once a month, and we should have an eclipse immediately before every new Moon were it not for the fact that usually the Moon passes just above or just below the Sun as seen from the Earth. This is because the orbit of the Moon is inclined at an angle to that of the Earth, as in Fig. 4, which shows two different positions of the Earth and the Moon when the latter is new. It is easily seen that in one of these positions the shadow of the Moon misses the Earth altogether, while in the other the Sun, the Moon, and the Earth are in line, and an eclipse takes place. Thus, instead of monthly eclipses, we only have from two to five in a year.

It is not very often that there are more than three eclipses annually, but the year 1935, which the majority of readers can reasonably hope to see, is remarkable in having the maximum number of five. These are not all total eclipses however, and it has been calculated that the total time available for actual experimental study of total eclipses amounts only to about 24 hours in the course of a century.

Jupiter's Crop of Eclipses

Contrast this with the time at the disposal of the highly-favoured inhabitants of Jupiter—if any could exist! Jupiter has nine moons altogether, but five of them are comparatively small. The other four are those first seen in 1610 by Galileo with his newly-invented telescope. Although they are about the same size as our Moon, their greater distance from the Sun makes their shadows longer, so that the solar eclipses due to these satellites on the giant planet are always total as well as more numerous.



The Planet Jupiter, showing one of its moons in transit at A. The black circle at B is the shadow of the satellite on Jupiter

The shadow cast by one of the moons on Jupiter is readily seen in a small telescope as a black dot moving across the surface, marking out a track of totality that we can see from the earth in exactly the same manner that our adventurous Moon voyager sees the one marked on the Earth by the shadow of the Moon. In the case of Jupiter it is not at all unusual for two solar eclipses to be in progress at the same time. On 5th April 1896, there were three separate total eclipses of the Sun within the short period of seven hours! An observatory on Jupiter would be a splendid place from which to study the elusive and changeable luminous corona that surrounds the Sun.

Primitive Ideas about Eclipses

The Sun was looked upon by all primitive people as a god, or at least as controlled by gods, and the effect of an eclipse on them may easily be imagined. They hastened in many cases to make up for past sins of omission by extra offerings and sacrifices. In other cases, as we have already seen, they endeavoured to drive away the dragon about to devour the Sun by making hideous noises with drums and gongs, and when the Sun reappeared from behind the Moon once more they naturally imagined that their efforts had appeased the anger of the gods. The Greeks, supposed to be a cultured and civilised race, were not free from superstitious fears during eclipses, and even as late as 1654 thousands of people in Central Europe were so afraid that they hid themselves in cellars when the light of the Sun faded away. Such an event has now no terrors for the civilised world, although it must be confessed that a woman died of fright in Iowa, in the United States, during the eclipse of 1869.

Eclipse Ends a War

Many strange tales are told of the days when it was recognised by only a few men that eclipses were perfectly natural phenomena and could even be predicted. Herodotus, the earliest of Greek historians, refers to an occasion when darkness suddenly descended while a battle was being fought between the Lydians, a people of Asia Minor, and the Medes, from the mountains north of Persia, with the result that peace was declared on the spot between the terrified combatants! This has been thought to be a reference to a famous eclipse of the year 585 B.C. the chief title of which to fame is that it is the first one known to have been foretold in Europe.

The philosopher who successfully predicted this eclipse was Thales, of the city of Miletus on the coast of Asia Minor. Thales had some strange ideas on astronomical subjects. The Earth he considered to be a large island surrounded by water, while he figured the sky as a huge crystal bell set over the Earth with the stars as gilt headed nails driven into it. But he has two great achievements to his credit. One was the discovery that the Lesser Bear, including the Pole Star, was a far better guide to mariners than the Great Bear, and the other was this successful prophecy.

Predicting Eclipses 2,500 Years Ago

By some method he had obtained the knowledge that eclipses took place at intervals of about eighteen years, and to predict the eclipse of 585 B.C. he must have been aware of a previous one

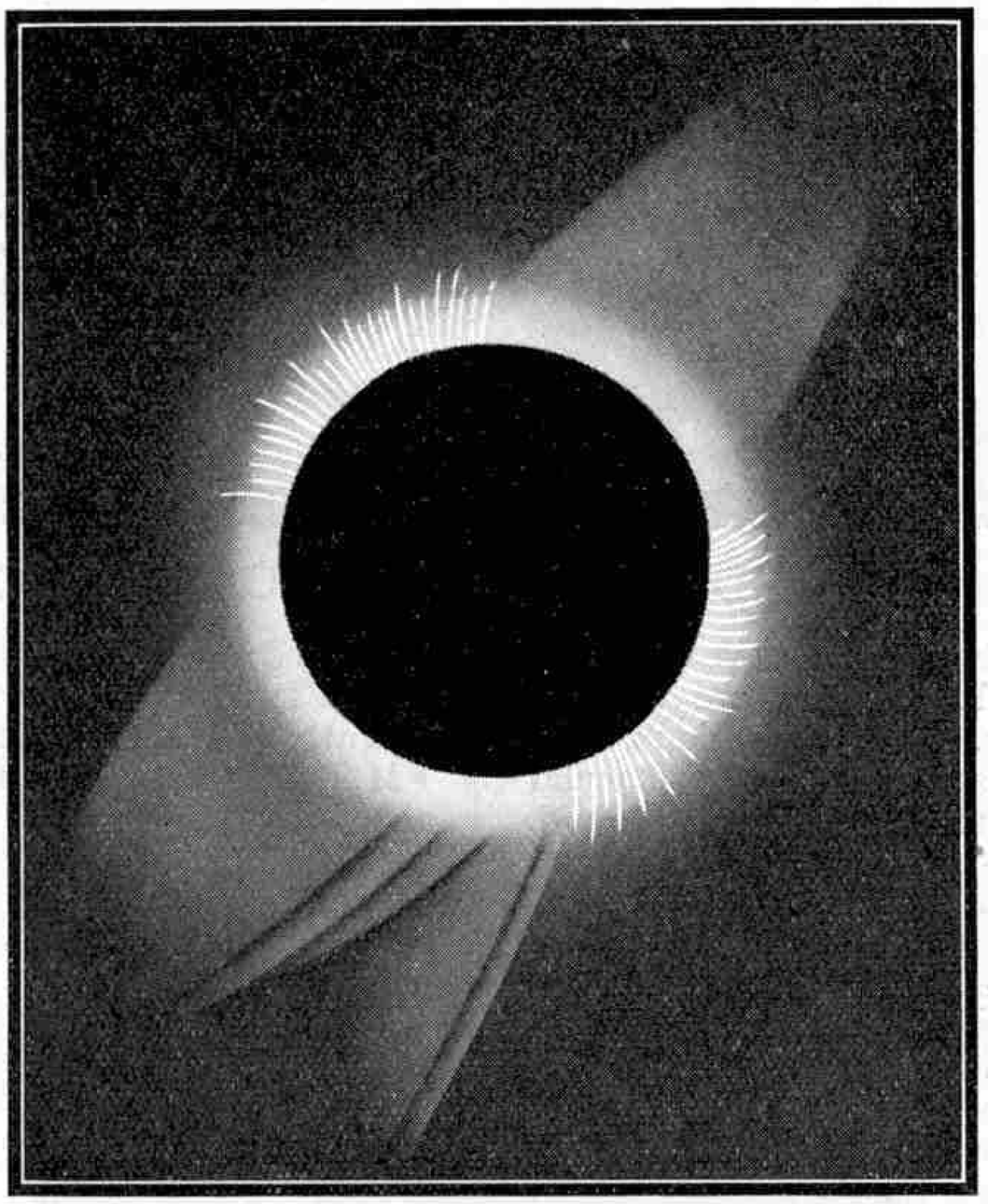
in the year 603 B.C. This period of eighteen years is called the Saros. It was discovered by the astronomers of Babylon in the 7th century before the Christian era, and Thales probably derived his knowledge of it from them.

The method of the earlier astronomers is not without interest, as it expresses roughly the conclusions arrived at by modern methods. The Saros enabled the old astronomers to foretell that an eclipse would be followed by another after a period of about eighteen years, but was of no use for the prediction of the beginning of a series of eclipses.

The actual duration of the Saros is 6,585⅓ days, and is the length of time required for the return of the Moon and the Earth to the position in which the Sun is once more eclipsed. Thus a total eclipse of the Sun took place in the year 1865 and this has been followed by a series of eclipses at the correct intervals in 1883, 1901 and 1919, a series that will be continued in the years 1937, 1955 and 1973. A similar series of eclipses took place in the years 1850, 1868, 1886, 1904, and 1922, the intervals again being ten or eleven days over eighteen years.

Two other points of interest are easily discovered if we mark the tracks of totality of the successive eclipses of such a series on the map of the world. The first is that the track of any eclipse is always about 120° west of the track of the previous one of the series. This is the result of the one-third of a day that figures in the Saros number, this extra time allowing the Earth to make a further one-third of a revolution before the eclipse takes place.

A glance at the map (Fig. 2) will make this clear. The curved lines just below the Equator show the tracks of a series of eclipses, the date of each one being marked underneath, and it will easily be seen that each line is roughly 120° west of that of the eclipse that happened eighteen years previously. On a globe this would show as one-third of the way round the Earth. At the end of three periods an eclipse returns to the same general region on the Earth, but will be about 600 miles either north or south of the position of the one 54 years before. This also is clearly shown on the map, which gives the tracks of the series of eclipses from 1865 to 1973 already referred to.



Total Eclipse of 29th July 1878, showing the beautiful coronal streamers stretching for millions of miles into space

Accuracy of Modern Predictions

It is amusing nowadays to read of the wonder excited in the old historian Herodotus by the remarkable success of Thales in predicting, not merely another eclipse, but the actual year in which it happened. This was certainly a great feat at that time, but enormously greater accuracy is now possible. Modern methods not only give the date of future eclipses, but also the length of time during which the Sun is hidden behind the Moon, and the exact position on the Earth's surface of the line of totality.

The degree of exactness reached by modern astronomers in their predictions is best illustrated by a comparison of calculated and observed times of past eclipses. A Bohemian observer named Leovitius was so deceived in 1555 by the astronomical tables he used that an eclipse of the Moon happened more than half-an-hour later than he expected. By 1878 methods had so improved that the error in the case of the eclipse of the Sun visible in that year in America was half a minute, and in the case of the 1925 eclipse, also visible in America, the difference between the observed and calculated times was only about five seconds. In this latter case the actual track of totality was about half a mile narrower than the calculated one and a little further north.

It is interesting to recall the circumstances of the last total eclipse in England, in 1724. The calculations on that occasion were made by Dr. Halley, the famous astronomer who foretold the return of the well-known comet that bears his name. The map that he drew placed London just outside the path of totality, and the observations on the 22nd of May in that year fully confirmed this.

A Turk's Opinion of English Astronomers

Great interest was taken in the event in Royal circles and an amusing story is told of a sceptical Turkish envoy to the court, who scoffed at the idea that the heretical English could know so exactly when the Almighty would overshadow the Sun while the Moslem world remained in ignorance. But when the Moon did obscure the Sun in almost exact accordance with Halley's prediction, he expressed the opinion that the latter had obtained his knowledge from the devil, for he was sure that God would never correspond with such a wretched set of unbelievers as the English astronomers! Had he been in England nine years earlier, he would have seen Halley predicting another total eclipse successfully, that which occurred in 1715, the last one visible from London.

The possible number of eclipses in one year ranges, as we have seen, from two to five, and in the present year there are three. The first was annular and was seen on the 3rd January as a partial eclipse by the inhabitants of the west coast of South America and the east coast of Australia. The second is the total eclipse of 29th June, while the third will take place on Christmas Eve and will be a partial eclipse visible from places in the southern hemisphere.

The second of these eclipses is, of course, the one in which we are interested, and in next month's article we shall deal with it in detail and reproduce a map showing the position of the track of totality. As the Moon shows slight irregularities in its movements, it is difficult to say with absolute accuracy just where the lines representing the edges of the central shadow will be. Any inaccuracy in the case of the coming eclipse, however, will certainly be as small as that observed in the case of the American eclipse of 1925 already referred to on this page, and there will be no risk of missing the total phase if a place near the middle of the track is chosen as an observation point. Our map will enable readers to select the most suitable positions.

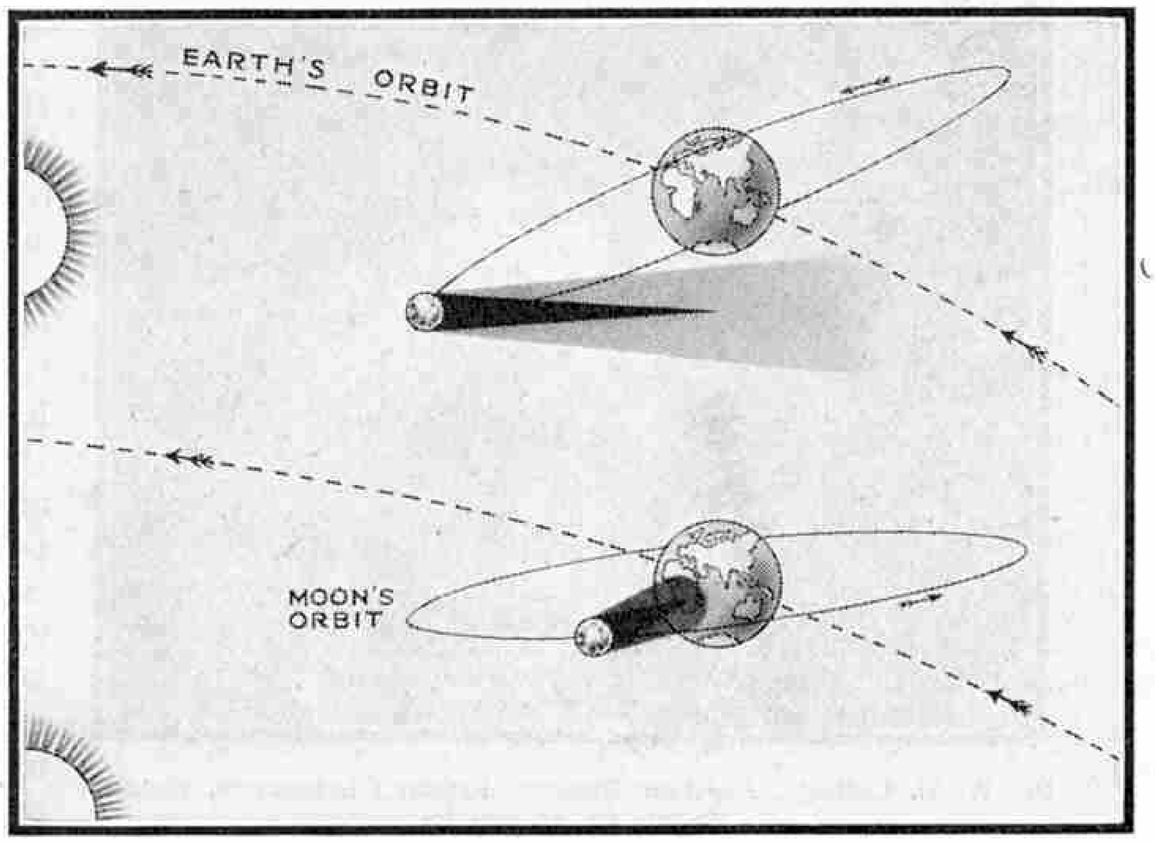
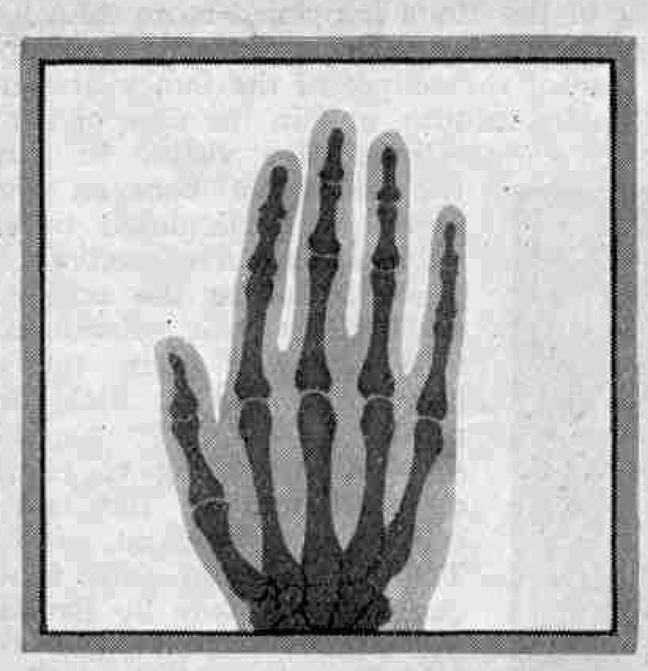


Fig. 4. Diagram showing (top) how the Moon's shadow may miss the Earth and (below) how an eclipse occurs when the shadow falls on the Earth



Electricity

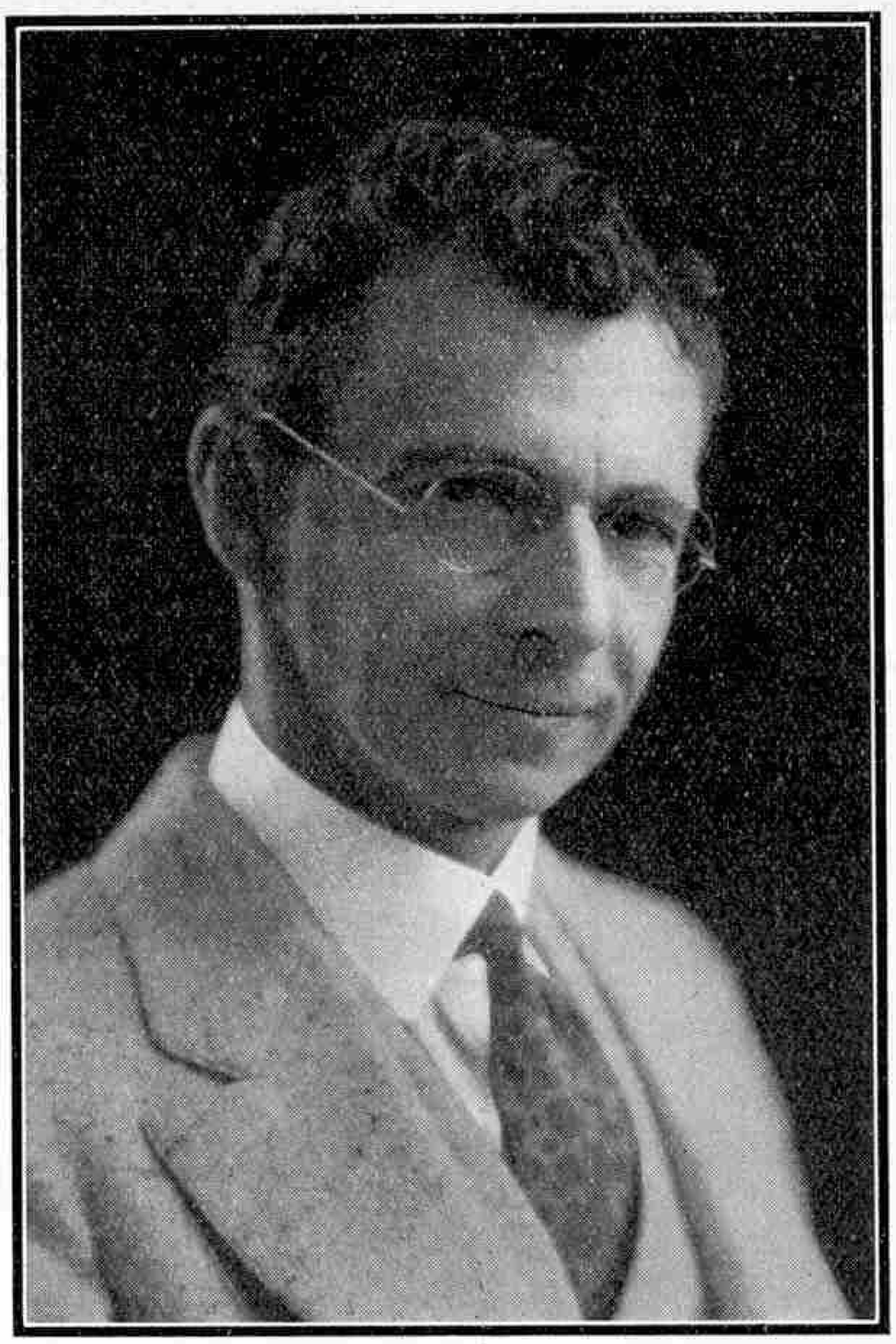
XXXIV. THE INDUSTRIAL APPLICATION OF X-RAYS

IN the previous articles of this series we have seen how X-rays are produced and how they are used in medical and surgical work. The application of the rays to the latter work was so successful and spectacular that other applications were somewhat overshadowed.

It is, however, a great mistake to think that the medical applications of the properties of X-rays are the only ones in use. There are many others, and when the history of the science of to-day comes to be written it will probably be found that the medical applications are the least important. To diagnose a displacement, a fracture or a disease in an individual is a great achievement as far as the medical world is concerned, but to-day X-rays are being used on an increasing scale in industry, and in this article we propose to deal with some of the various ways in which they are now employed.

Early Use of X-rays by Post Office

It is interesting to recall that, within five years of Röntgen's discovery, the British Post Office set up a plant for the detection of flaws in the gutta-percha used for submarine cables, and later it was used for the examination of the lead sheathing of underground wires. These applications are characteristic of the use that has since been made of the rays. It will be noted that in each case the material under test is in the form in which it is to be used, and this is of the utmost importance in dealing with constructional materials such as wood, steel, or concrete.



Dr. W. D. Coolidge, Assistant Director, Research Laboratory, General Electric Co. of America

In order to realise to the full extent the importance of tests of this character it will be necessary first to consider other testing methods available. These may be described as being mechanical, chemical, or microscopical.

The forms taken by the usual mechanical tests have recently been described fully in the article in the January "*M.M.*" dealing with the materials used in the construction of the Sydney Harbour Bridge. The testing machines there mentioned perform their work by destroying a sample in some way, so that the material actually tested is not used in the construction of the bridge at all ! Chemical analysis is also a method of testing that involves the destruction of a sample, while microscopical tests find very limited use, being of value only for the examination of surfaces or chosen sections of the materials tested.

Dangers of Testing by Samples

These methods have the common defect of testing samples only. Such tests are exceedingly valuable, but it cannot be said that they always give an absolute guarantee of the character of the material from which the sample was chosen. It can never be absolutely certain, for instance, that every one of a large consignment of steel bars has the same tensile strength as the samples submitted to test, and there always remains the possibility that one of the bars may contain a flaw that makes its use dangerous. The writer has painful recollections of a motor accident due to the breaking of a rear axle shaft that proved, on examination, to have a flaw at one point in it, extending over two-thirds of the cross-section, of a kind that could hardly be detected by any ordinary means.

This breakage of an axle shaft is not only an excellent example of the dangers attached to the more usual methods of testing, in which samples only are examined, but also illustrates the fact that mechanical trials of

machinery or finished work are not sufficient safeguard. A faulty weld, or inferior material or workmanship in a vital part may not show themselves at all in the test-bay run of an engine or motor, and may only become evident as a result of continued use or of exposure to steam or oil. Further there are many cases in which practically no tests of finished work can be applied at all.

To sum up, then, none of the ordinary tests can usually be applied to such finished work as a crankshaft or a concrete pillar, and therefore they do not carry absolute conviction. The discovery of X-rays has altered this, however, and given us additional tests of an entirely new character.

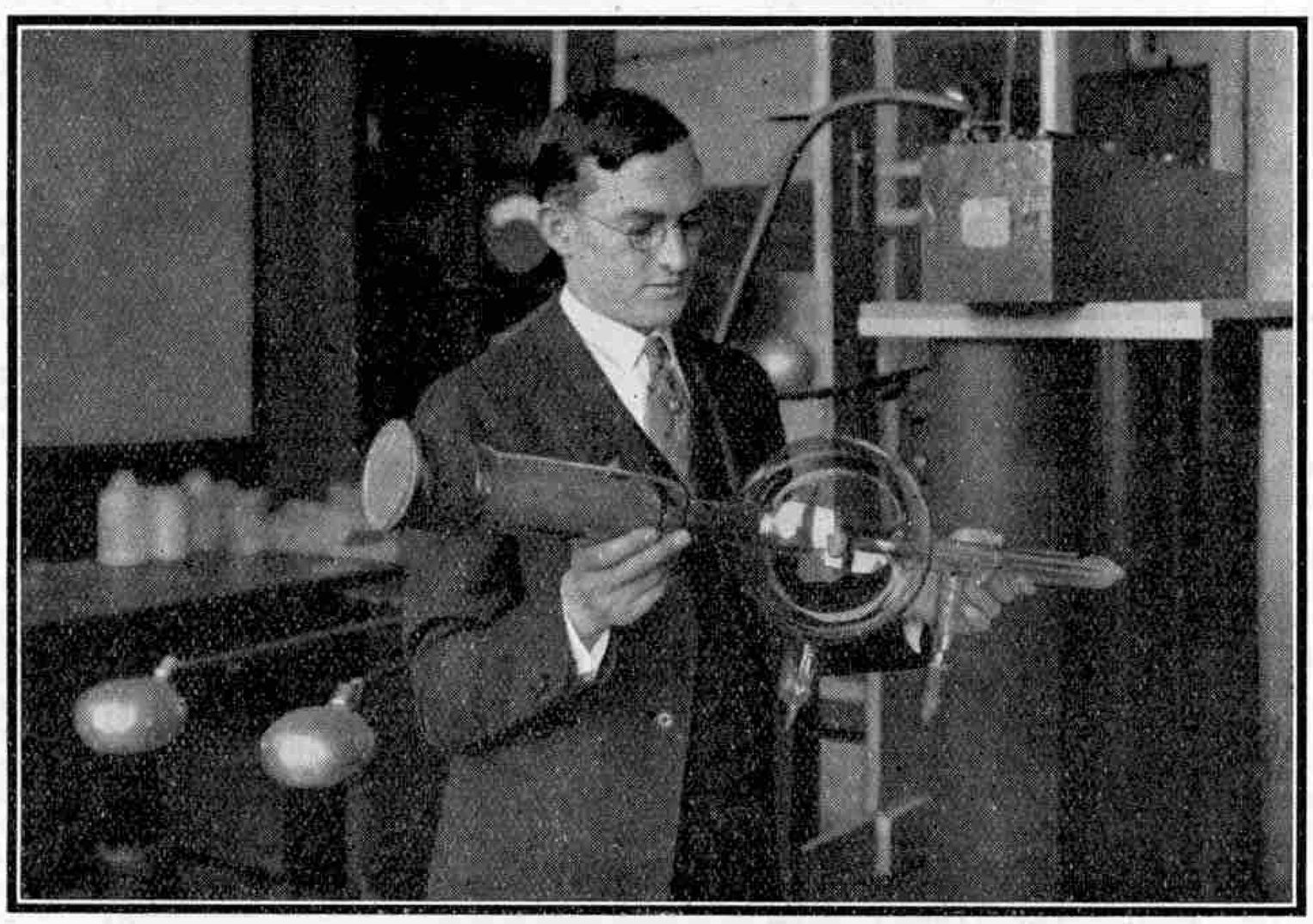


Photo Cathode Ray Tube [*G.E.C. America*

The X-ray Way

These tests depend upon the fact that different substances have greatly different powers of absorption of X-rays. A convenient method of comparing practically the absorptive power of different substances is by the use of the "half layer value," or the thickness of the material that will reduce the radiation passing through it by half its value. Usually, however, it is assumed as a practical guide that the absorption of any material is roughly proportionate to the density. Thus aluminium is more penetrable than iron and steel, and the latter than lead or tungsten.

None of these metals is easily penetrable, however, and that is why the growth of the use of X-rays in industrial work has been slower than in medical work. Metals, and most of the solids dealt with, absorb X-rays far better than do flesh and bones. Some idea of the greater difficulty in the case of metals is given by the fact that the bones of the head can be thoroughly examined with rays that would not penetrate one-tenth of an inch into steel. Very penetrating rays are necessary, therefore, and it is only the development of the Coolidge tube already described that has made possible the examination of steel castings of any considerable thickness.

An estimate of the maximum thickness of various materials that can be satisfactorily examined at present gives 15 inches for wood, but only five to six inches for aluminium, one-fifth of an inch for lead, and in the case of the most important of all, iron and steel alloys, three inches. This may be extended in favourable circumstances to as much as four inches in the case of steel, while at Loughborough College successful photographs have been taken through five inches of cast iron. But this is not sufficient to enable heavy metal work to be examined.

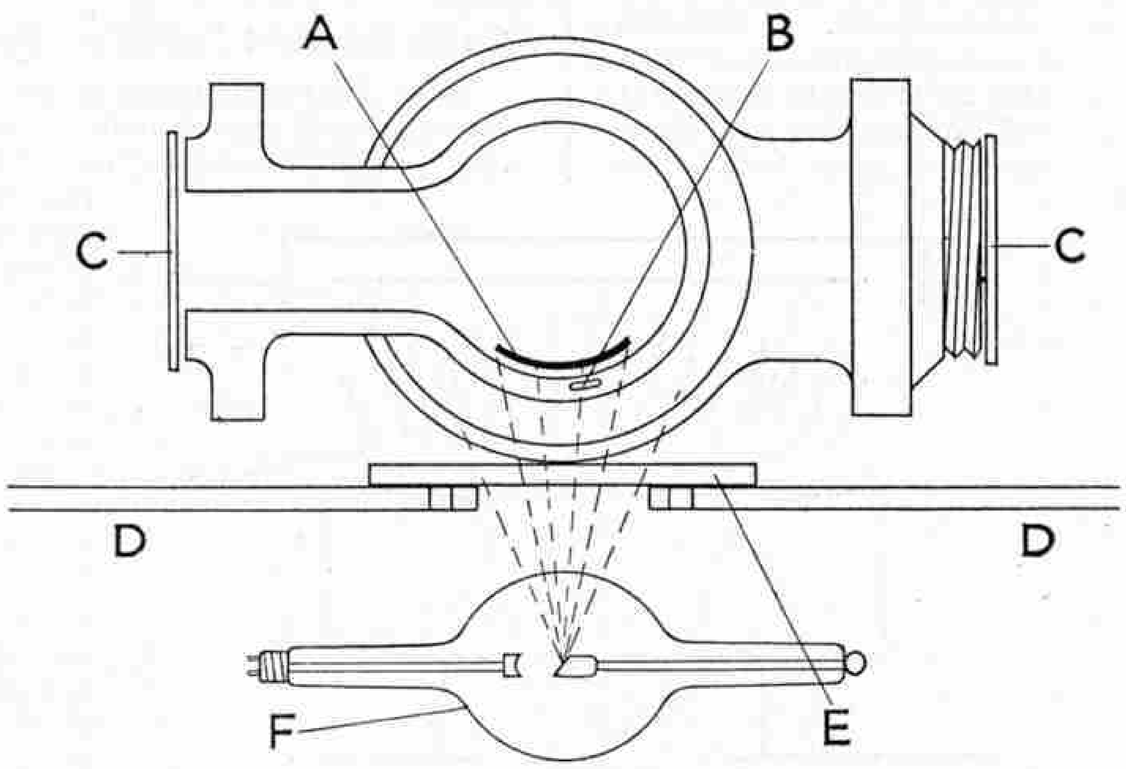


Fig. 1. A Heavy Casting under X-ray examination

Greater Voltages Necessary

If further advances are to be made it will be necessary to make use of even more penetrating radiations produced by much higher voltages. The practical commercial limit of the latter at the present time is 250,000 volts, giving penetrating power, as stated above, of three inches in steel. It has been estimated that the use of 600,000 volts will increase the range in steel to six inches. The nearest approach yet made to this is the 350,000 volts used by Coolidge.

As related last month, Coolidge applied this voltage to one of his X-ray tubes that had been modified by removing the target, and so obtained a stream of electrons in the air. By the courtesy of the General Electric Company of America we are able to reproduce photographs of the tube and the transformers used by Coolidge, and in the one on this page the window of nickel foil can be seen quite plainly. If the stream of electrons produced by this voltage could be used in an ordinary Coolidge tube, the X-rays excited would be more penetrating than the best now produced, even if they would not penetrate steel to the depth of six inches. The problem is largely one of efficient cooling of the anticathode, as the heat produced by its bombardment would be almost enough to melt it.

The most obvious use of the rays in metal work is in the detection of flaws. A cavity in a piece of metal under examination would show itself quite clearly in an X-ray photograph as a dark patch on the negative, since rays would pass through it more easily than through the rest of the material. On a positive print, of course, it would show as a light patch.

Fig. 1 shows how an examination is carried out.

The work to be examined, in this case a finished casting, is placed between the bulb of an X-ray tube, F, and a photographic film or plate A. The tube is contained in the metal box D, lined with lead, in the top of which is a square opening of variable size. The opening is covered by a lid made of some material such as ebonite that allows the rays to pass through it easily, and upon this the work to be examined rests. The open ends of the casting are closed by lead plates C, and for further protection from the rays the controlling apparatus is located outside the room. A lead-lined periscope is usually provided to enable the operator to see the tube. A flaw in such a position as B will then reveal itself on the photographic plate A.

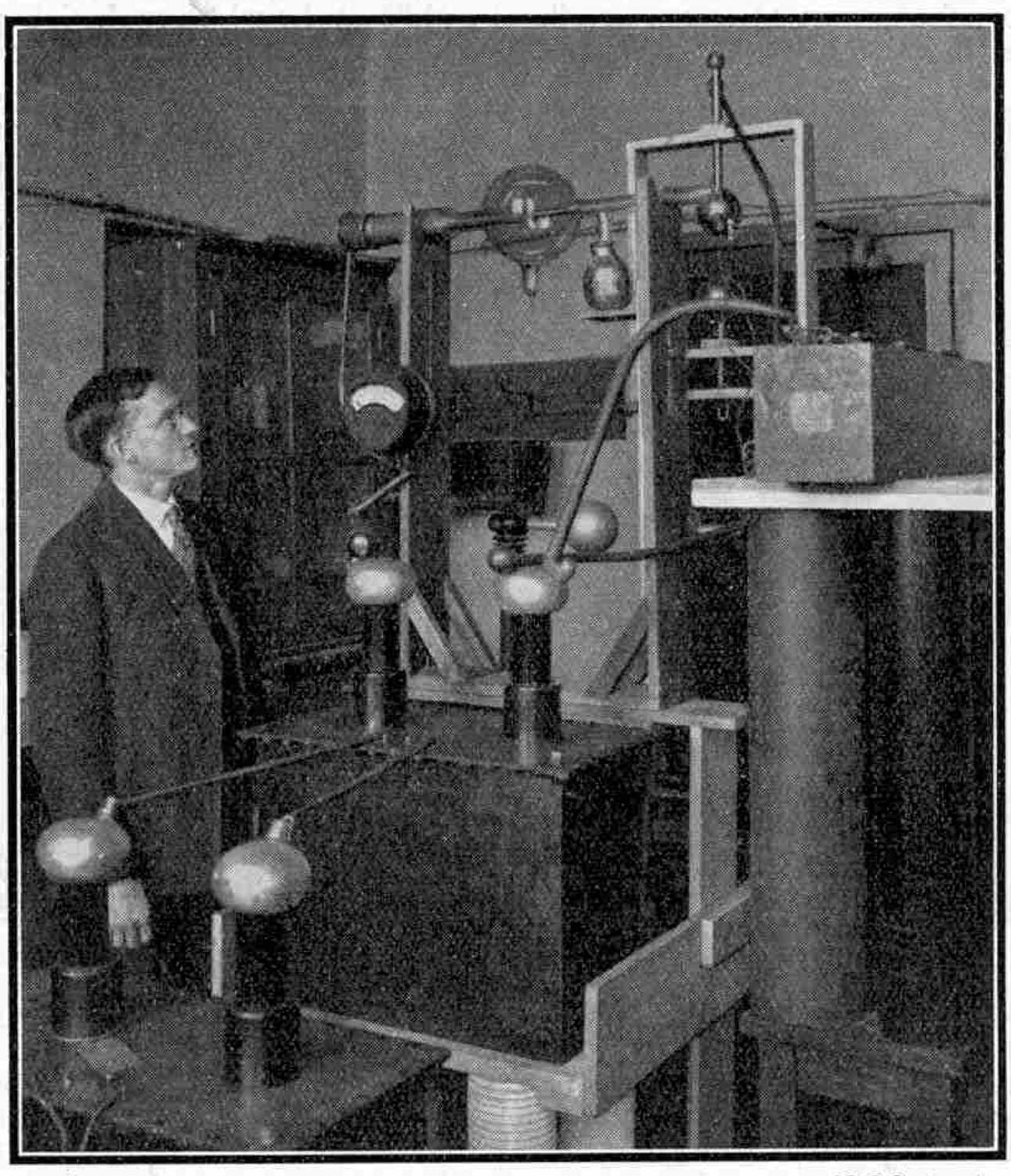
For identification purposes a number cut out in lead is very often fixed in such a position that its shadow will appear in the photograph. Exposure may be anything up to 30 minutes or even more, depending on the thickness of the metal to be examined. In cases where the thickness of metal is not uniform, over-exposure of the thin section is prevented by covering it with a thin screen of lead, which makes the effective thickness of the sample the same throughout.

A Difficulty in Long Exposures

When X-rays fall upon a material, secondary X-rays are emitted which are scattered in all directions. Most of the scattered radiation emanates from the surface of the bodies encountered, and may cause fogging of the photographic plate by X-rays being thrown on to the plate or reflected back to the plate. Where the time of exposure is short, little trouble is experienced, but with heavy sections elaborate precautions must be taken if successful radiographs are to be obtained, particularly in the case of irregularly shaped castings. The usual method of protection is to surround the casting with a substance opaque to X-rays so that the only radiation reaching the plate is that passing through the casting. The most opaque substance readily obtainable is lead, and this may be used either in the form of sheet or as lead shot. Wax containing powdered lead and also mercury is sometimes used.

In medical work a device known as the Potter Buckey Diaphragm is used to reduce the effect of scattered radiation. The diaphragm consists of a large number of lead strips placed radially, so that whilst allowing the primary X-rays to pass to the photographic plate, scattered rays are stopped. The arrangement is shown diagrammatically in Fig. 2. As the arrangement stands, shadows would naturally be cast on the plate by the grating strips, and when such shadows are not wanted the grid is given a circular movement. There is little doubt that its use will in the near future be of considerable assistance in X-raying metal castings.

Generally speaking it is impracticable when X-raying iron and steel to take the apparatus to the work. If, however, suitable lifting appliances are arranged, it is possible to convey quite heavy articles to the X-ray tube. Hydraulic Cylinders weighing over half a ton, having a maximum thickness of about 4 in. have been examined at Loughborough College. In some cases a film is used which can be bent to fit the inside of the cylinder as in Fig. 1, the X-rays penetrating from the outside.



Photo] [*G.E.C. America*

Cathode Ray Apparatus

Results of X-ray Tests

In studying X-ray photographs produced in this manner valuable information with regard to the nature of the flaw can be obtained from the density of the shadow. Thus a very deep tone in the spot or mark produced on the negative by a flaw shows that the X-rays have had a very easy passage through some portion of the material examined, and that the flaw is of a very serious nature. The method is very sensitive, and is quite capable of detecting in commercial castings any flaws that are sufficiently serious to require consideration.

The defects revealed in castings by these methods are of several kinds. Blow holes due to gas from dirt, or the sand in the mould, or to steam from a damp mould, usually show themselves on the radiograph as rounded spots. Occasionally the gas has moved through the metal, leaving a bore like a worm hole, and the resulting photograph somewhat resembles a picture of a small comet. If a mould has not been made sufficiently firm, sand may be taken up by the molten metal during the casting process, and the rays will show its presence as it is easily penetrated by them.

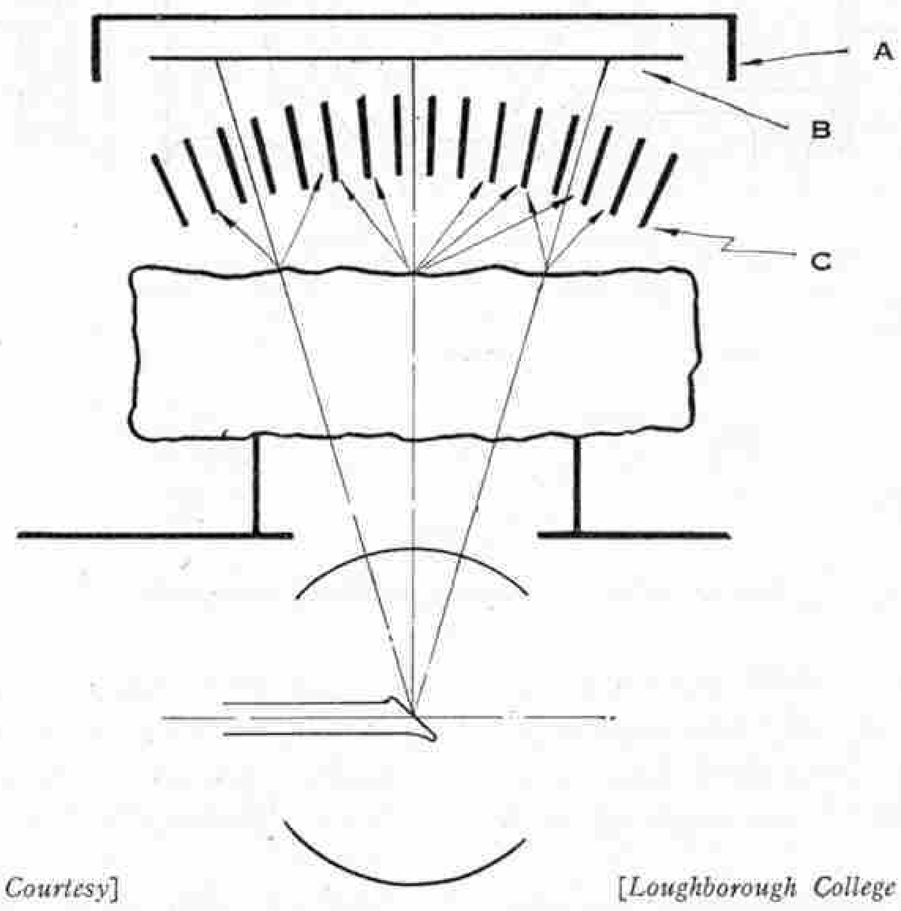
Cracks the Most Dangerous Faults

In making steel castings the metal contracts on cooling, and if the reserve of molten metal is not sufficient to keep the mould full, spongy sections will be present in the resulting castings. These are the most common faults in castings, and they are not always serious, but X-ray examination of suspected materials will enable a reliable judgment to be formed. The most dangerous of all faults are cracks, as they have a well-known tendency to spread and, unfortunately, it is somewhat difficult to detect them.

The difficulty was very aptly stated by Dr. J. Hall-Edwards, whose X-ray work was referred to last month, as follows :— "In looking for a crack in a steel rod it must be borne in mind that one cannot see through a key-hole unless one's eye be opposite it; hence, unless the crack be in line with the path of the rays, it may be overlooked."

For this reason it is best, in examining work that is liable to contain cracks, to take a series of radiographs at varying angles so as to detect cracks running in different directions.

A very important example of this kind of X-ray examination is furnished by the examination of joints made in metals by welding, brazing, soldering, or riveting. Next month we will give illustrations showing results of such examinations, and describe other uses of the rays in industry.



Courtesy] [*Loughborough College*

Fig. 2. The Potter Buckey Diaphragm
A. Protective Lead Shield. B. Photographic Plate. C. Lead Grating

NOTES FROM THE ZOO

Owl Caught on Atlantic Liner

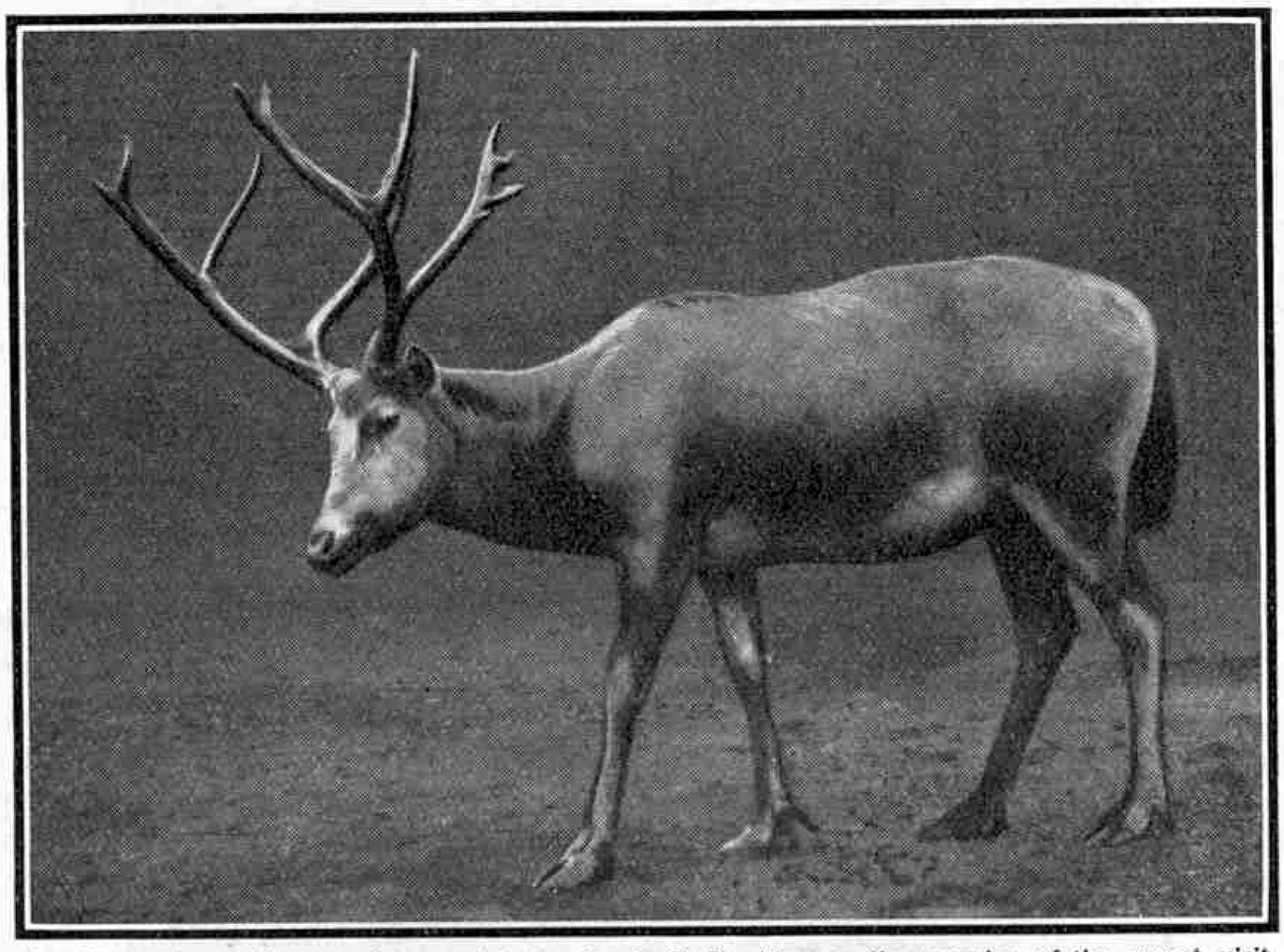
An owl with an adventurous history is numbered among recent arrivals at the Zoological Park at Edinburgh. When the "*Cairnross*," a steamer belonging to the Cairn line, had reached a position about 500 miles west of Belle Isle during a recent voyage across the Atlantic Ocean, two owls flew on board. One of these tried to alight on the funnel, and dropped back into the sea, probably overcome by the fumes, but the other one was captured by the crew of the vessel.

A similar incident was reported on the arrival at Southampton of the Cunard liner "*Berengaria*." To the astonishment of all on board an owl alighted on one of the wireless insulators and then flew down to the aft galley funnel, where it was caught by one of the seamen. In comparing the accounts of the crews of the two ships there seems to be a possibility that the owl which settled on the "*Berengaria*" was the one that had fallen back into the sea from the "*Cairnross*." The two were not far away from each other at the time, and both accounts agree in describing the bird as having white plumage with brown spots on the wings and large amber coloured eyes. Unfortunately, the one that alighted on the "*Berengaria*" was liberated at Southampton, as the Cunard authorities did not learn of the "*Cairnross*" incident until that vessel arrived at Newcastle later.

Mr. T. H. Gillespie, Director-Secretary of the Zoological Park at Edinburgh, has informed us that the bird received there from the "*Cairnross*" is a snowy owl and that several specimens have recently been picked up at sea in the north Atlantic, one of these also being now in his care, while several more are now in the London Zoo. In a recent article in the "*Scotsman*" Mr. Gillespie gave some further interesting information, from which we quote the following:

"The snowy owl is distributed over the northern (Arctic) parts of Europe, Asia, and North America, and during winter it moves southward to some extent, occasional specimens reaching the North of Scotland, but it is very unusual to hear of so many being found at once so far south, and so far out to sea. The snowy owl may fairly claim to be the most beautiful of its race. It is not the largest, for the eagle-owls exceed it in size, but it is a large bird as owls go. The plumage may be either entirely white, or it may be white more or less lined or spotted with black. The black markings on the two specimens just received are very pronounced. This owl hunts by daylight, even in bright sunshine.

The arrival of birds sent to the Zoological Park sometimes reflects in an interesting way the hazards and mischances to which wild life is exposed. Some years ago, for example, within the short space of a month or two, a large number of specimens of the little auk were received, all of which had been picked up on the East Coast in an injured or exhausted condition. Except during that limited period scarcely a single specimen of this bird has ever been sent to the Park, and its coming in numbers evidently followed some disturbances of range and habit, by wind or storm or food supply. The snowy owl has evidently suffered a similar disturbance this winter."



Our illustration is from a photograph taken by J. G. Cheshire, on the occasion of the recent visit of the Cranham Meccano Club to the Zoo. The deer allowed himself to be snapped with characteristic amiability

A Dragon Arrives in Amsterdam

Exactly what dragons were like we do not know. The legends regarding them tell us of their enormous size and scaly armour, their fire-breathing and other terrifying features, but it is probable that the old tales of these monsters have their origin in stories, passed down from one generation to another, of reptiles now extinct.

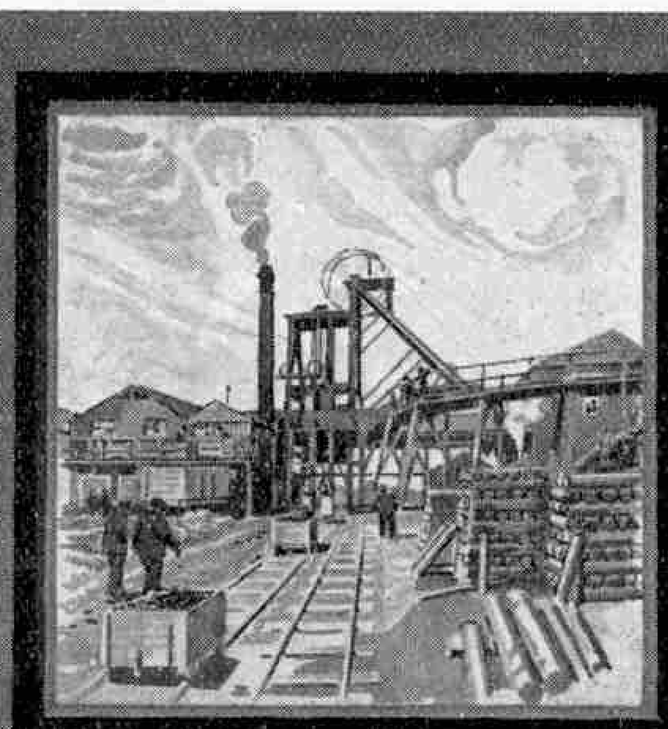
A specimen of a gigantic lizard, 9 ft. in length, which might well have given rise among primitive people to legends of dragons, has reached the Zoo at Amsterdam. There were already two smaller ones in the New York Zoo, and all three were trapped on Komodo, an island about the size of the Isle of Man, in the Dutch West Indies. Very few people live on the island, which is not surprising when we learn that some of these lizards grow to a length of 30 ft., and that they are capable of running down and devouring wild ponies!

Komodo has been little visited by man, and is wild and gloomy in character, with huge caves and rocky holes in the interior. Not having been disturbed, therefore, these lizards have developed and increased in numbers until they have become almost the undisputed rulers of the island.

* * * *

Tortoise Born in England

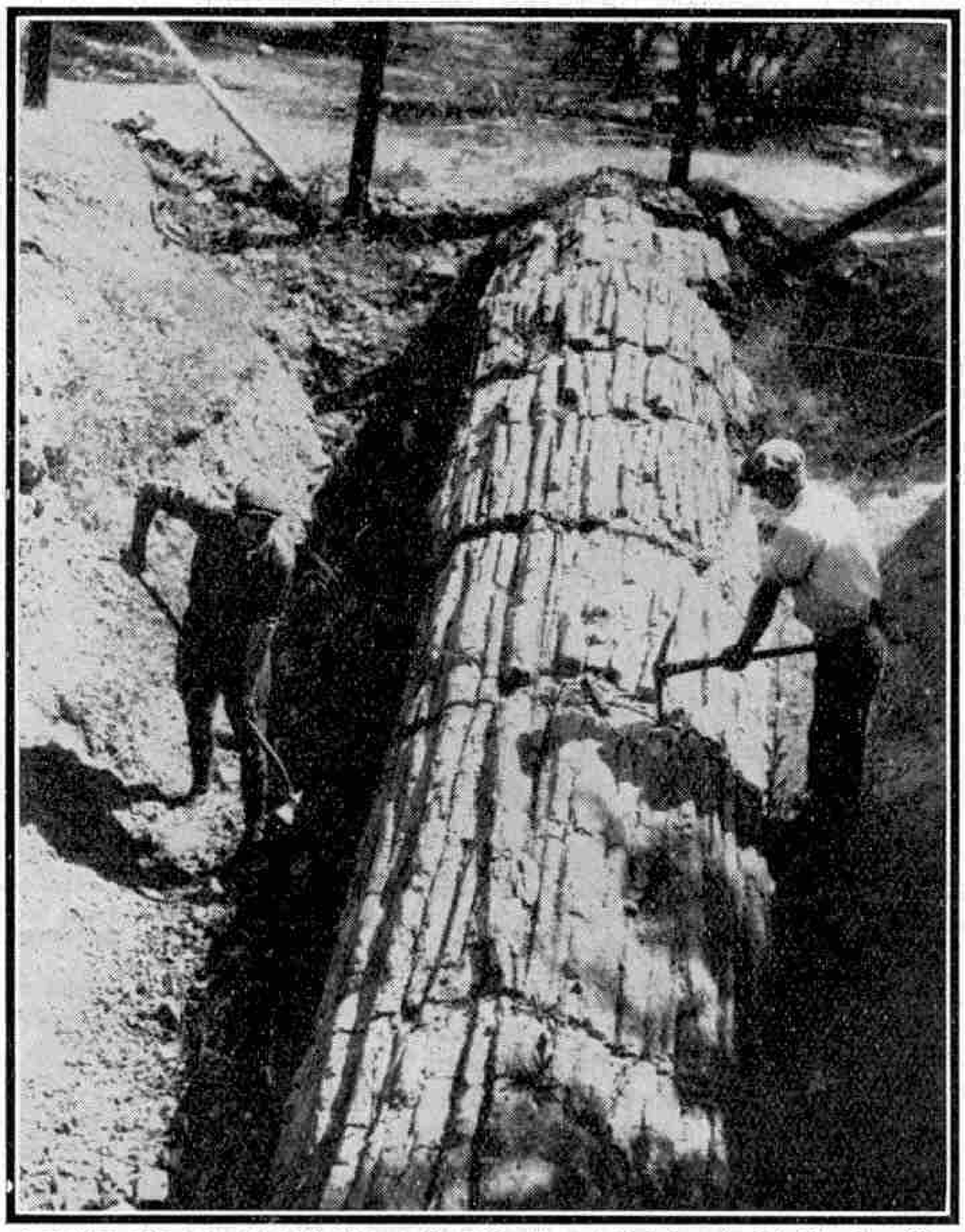
A belief that the eggs of the common tortoise could not be hatched in this country has quite recently been disproved by the success of an attempt by a Dulwich resident, who hatched one out by the application of continual warmth. As a matter of fact this is not quite an unprecedented event, as the eggs of an African variety of tortoise were hatched at the London Zoo some years ago. In this latter case the eggs were hatched by burying them in warm deep sand, in imitation of the method used by the tortoise itself.



THE STORY OF COAL

LAST month we described how the tropical vegetation of pre-historic times became gradually transformed into coal and peat, lignite, bituminous coal and anthracite were seen to be various stages in this process of conversion. We come now to the story of coal mining, and the part coal has played during the last three centuries in furthering industry and invention.

The earliest reference to coal is in all probability that made 2,300 years ago by the Greek philosopher Theophrastus who, in writing of "Stones," put on record that :—"These fossil substances that are called coals and are broken for use are earthy. They kindle, however, and burn like wood coals. These are found in Liguria and in Elis, and are utilised by smiths." Liguria is the modern province of Genoa in North West Italy, and was conquered by the Romans about 150 B.C. after 80 years of intermittent fighting. Elis was a country in the west of ancient Greece and ultimately also fell under Roman rule. It was the scene of the original Olympic Games, which had existed for unknown ages. These famous games died out about 4 A.D., a couple of centuries before earthquakes and landslides devastated the country.



A section of a huge Red Wood tree, found in the petrified forest of California. The forest was buried in volcanic ash in an eruption of Mount St. Helena ages ago, and the wood subsequently turned to stone. Every detail of the bark of these pre-historic forest giants is clearly preserved and the colouring of the stone is wonderful, ranging from opalescent pink to ochre. This tree is about 100 ft. in length, but the largest is 120 ft. long

Early Coal Mining in Britain

The Romans who invaded and established themselves in Britain built a number of their encampments close to what are now known as "outcrops," that is coal seams lying close to the surface and exposed in places. During the modern excavation of some of these ancient forts in Lancashire and Durham, cinders have been found. In some of the stations along Hadrian's Wall—that remarkable 73-mile barrier extending from Wallsend on the Tyne to Bowness on the Solway, and built at the Roman emperor's command in 120 A.D. as a defence against the northern barbarians—stores of unused coal are reputed to have been disclosed. The re-opening also in comparatively recent times of primitive outcrop workings has revealed in some of them tools since identified as Roman implements. Curiously enough no reference to the evident use of coal for fuel in Britain is contained in the writings of any of the Roman historians, although mention is made of "gagates" (jet) being abundant. Jet was greatly valued by the Romans, who shipped it to Rome where it was fashioned into many ornaments.

Domesday Book ignores Coal

With the eventual withdrawal of Roman activity and enterprise from Britain all appreciation of coal seems to have ceased for many centuries. It is true that one of the conditions upon which the Abbot of Peterborough, about 850 A.D., let certain lands was that a dozen loads of coal should be delivered to the monastery in the course of each year. But it is significant that there is not a single reference to coal throughout the voluminous Domesday Book. This monumental work was compiled by William the Conqueror in 1086-7 in order to discover how much land and property could be taxed, and it was said of the book that not so much as one pig was overlooked ! It is evident, therefore, that coal had not yet become generally recognised as a useful fuel.

In the thirteenth century, however, coal began to be

used regularly in the monasteries, and the monks may be said to have begun the coal industry of this country.

The monks of Newminster Abbey seem to have been among the earliest users of coal. A charter by Adam de Camhous, granting them some land on the coast near Blyth, mentions the inclusion of a road over which to convey seaweed for agricultural use and for transporting such "sea coal" as could be found over the allotted portion of the shore. Another grant obtained by the same monks was under charter from Nicholas de Aketon, and accorded them the privilege of gathering sea coal wherever they happened to find it in his wood at Middlewood, for use in the forge of their "Stretton Grange." Both these charters are known to have been issued before the year 1240 A.D.

Monks Ship Sea Coal to London

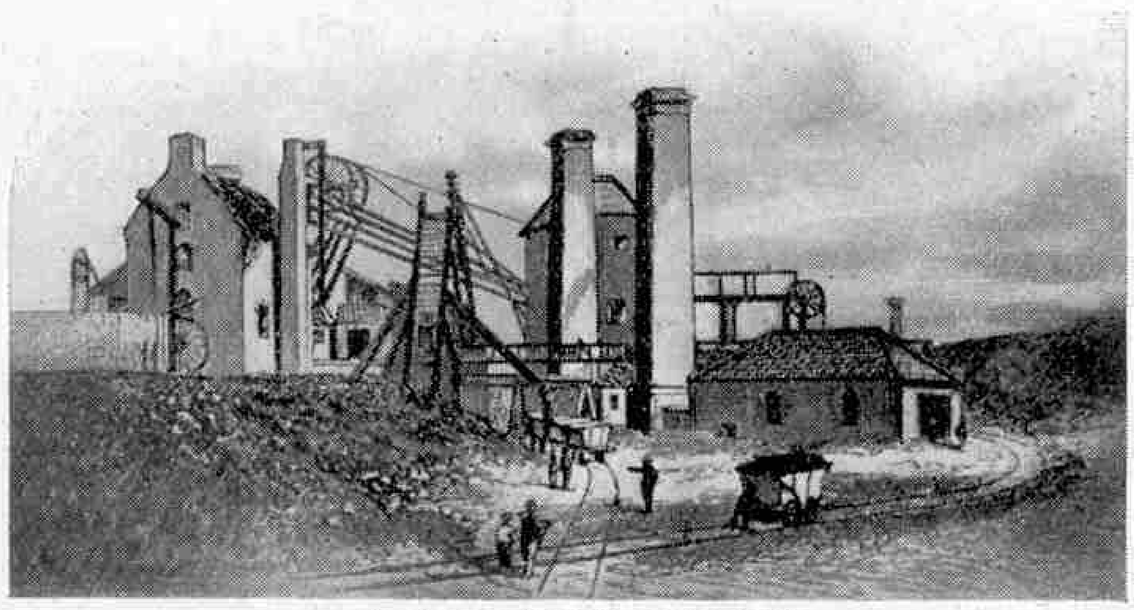
Some of the sea coal gathered from the shore outcrops of the river Blyth appears to have been shipped by the monks to London, for there existed in the metropolis in 1230 A.D. a suburban lane with the name of "Sacoles Lane." The character of this thoroughfare and the use to which the coal was there put are indicated by the title of "Limeburners Lane," which was also given to it.

The monks of Tynemouth were not slow to emulate the activities of their Newminster brethren. Outcrop coal in abundance was available on the extensive lands of which they were the fortunate owners, and the work of coal digging was early commenced, surplus supplies being shipped to London. One of the estate workings of the Tynemouth monks was at the village of Wylam, the birthplace of George Stephenson. History records that on one occasion, in the year 1269, several Newcastle men were arrested and tried for making a raid on North Shields, and also with having seized and decamped with one of the Prior's ships, lying there laden with coal.

A grant was made to the monks of Newbattle, some time between 1210 and 1219 A.D., to work a "coal pit" at Preston in Haddingtonshire, Scotland. In Scotland also a charter was granted to the Abbot and Convent of Dunfermline, Fifeshire, in 1291, conferring upon them the right to dig coal in the land of Pittencrieff. Finchdale Abbey and Durham Monastery also worked the outcrops in their respective vicinities on a large scale up to the time of the general suppression of the monasteries.

Coal digging in Lancashire began sometime during the latter half of the thirteenth century, and the sea coal that the monks of Bolton Abbey procured regularly as from the year 1294 is generally regarded as having been obtained from coal workings opened up in the Colne district. These purchases by the Bolton Abbey monks were to provide additional coal to that gathered by themselves, for lime-burning and to work their forges.

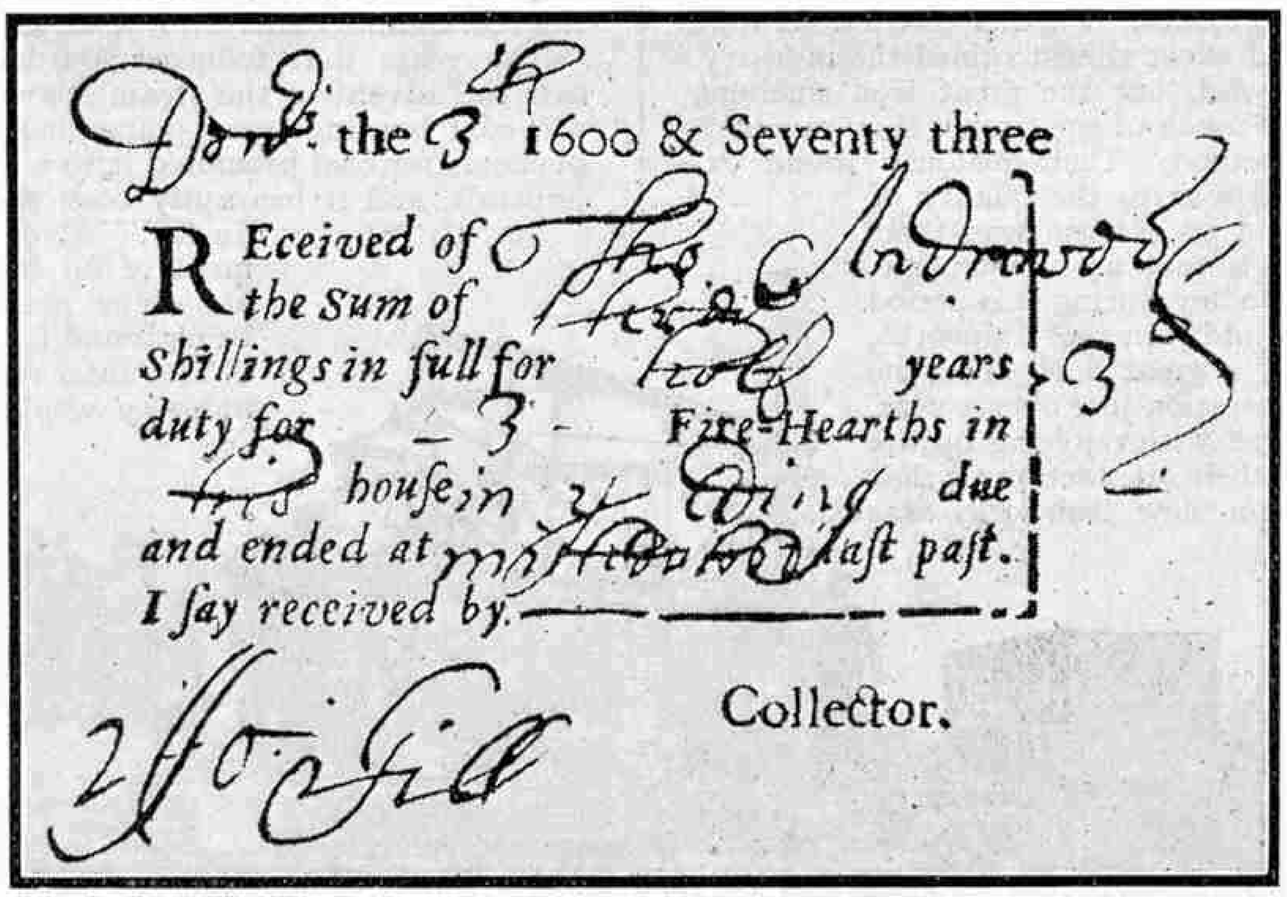
By the early part of the fourteenth century coal was being regularly worked also in the Cannock Chase district of Staffordshire, in Derbyshire and South Wales. The townspeople of Swansea obtained an important charter from William de Brews in 1305, granting them turf, peat, oak, dead and dry wood for ships and other building purposes. They were also given permission to have 'earth coal' in Ballywasta to meet their needs, but the charter strictly forbade any coal to be sold to strangers.



West Moor Colliery, Killingworth

Edward I. forbids use of Coal in London

As sea coal became increasingly used, at first chiefly for industrial purposes, London experienced its first smoke nuisance. Indignant and shocked citizens created a storm of protest and in 1306 Parliament petitioned King Edward I. to prohibit the use of coal, and this he did! Timber supplies were becoming less abundant, however, and the price of wood ultimately soared so high that people began to be glad to avail themselves of the new fuel. The royal order thus gradually became ignored and the smoke nuisance tolerated.



Receipt for Hearth Tax, issued in 1673

It is strange to recall that at one time coal smoke was utilised as a source of revenue by levying a tax upon every hearth or chimney! The tax was extremely unpopular, as might be expected. The state of affairs may be realised by the following account of the tax given by the historian Macaulay:—"The collectors were empowered to examine the interior of every house in the realm; to disturb families at meals; to force the doors of bedrooms and, if the sum demanded were not punctually paid, to sell the trencher on which the barley-loaf was divided among the poor children."

The amount of the tax was 2/– per hearth and in 1689, when it was abolished, it was producing £170,000 a year. The unfortunate householders did not benefit greatly by its abolition, however, for a tax on windows was substituted for it! This tax was much less unpopular as it obviated internal examination of houses by the

collectors, and it continued until 1851, when it was repealed.

Coal mining slowly developed and by the 17th century a systematic exporting of the mineral from Sunderland and Newcastle to London and ports on the Continent had grown up, while from the Lancashire coalfield a limited export trade to Ireland was carried on.

An interesting development arising out of the Newcastle export trade was the completion of the Victoria Tunnel about 1840. The tunnel took three years to construct, was two miles in length, 6 ft. 3 in. in width and 7 ft. 5 in. in height. It sloped downward under the town from Spital Tongues Colliery to the river Tyne and was used for the quick transporting of coal for shipment at Newcastle quay. Loaded wagons were set off at the colliery and descended under their own weight to the quay siding. When empty they were hauled back up the tunnel by a cable worked by an engine at the top.

First Iron-Smelting with Coal

A new and important use for coal was found by Dud Dudley, son of Lord Dudley, of Dudley Castle in Worcestershire, who in 1620 took out a patent for the smelting of iron with coal. Hitherto wood converted into charcoal had been solely used with the ore, but in Sussex the iron industry had developed so fast that timber supplies were rapidly diminishing.

Every ton of pig-iron manufactured took four loads of timber made into charcoal fuel, and for each ton of bar iron made, the extra charcoal burned required three additional loads of wood. Public alarm at the disappearing forests led to an Act being passed in 1581 prohibiting the conversion of wood into charcoal for iron-making within 14 miles of the Thames. Further restrictions were imposed later and the combined effect almost ruined the industry.

Dudley's method was successful, but the great iron smelters, embittered at being deprived of much of the timber they required, were resentful of the new method. Their jealousy found expression in spreading evil reports as to the quality of Dudley's coal-smelted iron, and so intense was their persecution that finally he had to give up the struggle.

One misfortune that befell Dudley during this period was the destruction of his new and principal ironworks, at Cradley in Staffordshire, by a great flood after the works had been in successful operation just over a year. The news of his loss was received with rejoicing by the ironmasters of the district, but their satisfaction on that occasion was short-lived, for a new ironworks was speedily erected and smelting with coal resumed.

The increasing demand for iron and the steadily decreasing available timber for fuel finally forced the ironmasters to turn to coal and Abraham Darby, an iron manufacturer of Coalbrookdale in Shropshire, was the first man to make a financial success of smelting by the new fuel. Others then followed suit and their general success soon firmly established coal as the all-important factor in iron-smelting and manufacturing, in place of charcoal.

In countries where extensive forestry operations continue to be carried on, as in Germany, Norway and France, the charcoal-burner is still a familiar figure. Nowadays, however, he is being replaced by organised parties that follow up the forestry gangs and convert into charcoal the stacks of timber left for them by the latter.

Photo] [*W. Coles-Finch*

An old Charcoal Burner at work

Forestry operations in France create nearly nine million tons of waste timber every year, and it has recently been found that the patent charcoal fuel obtainable from this waste can be successfully used as a substitute for petrol, for the driving of motor vehicles. Thus a new lease of life has been given to a fuel the history of which dates back to a very remote period.

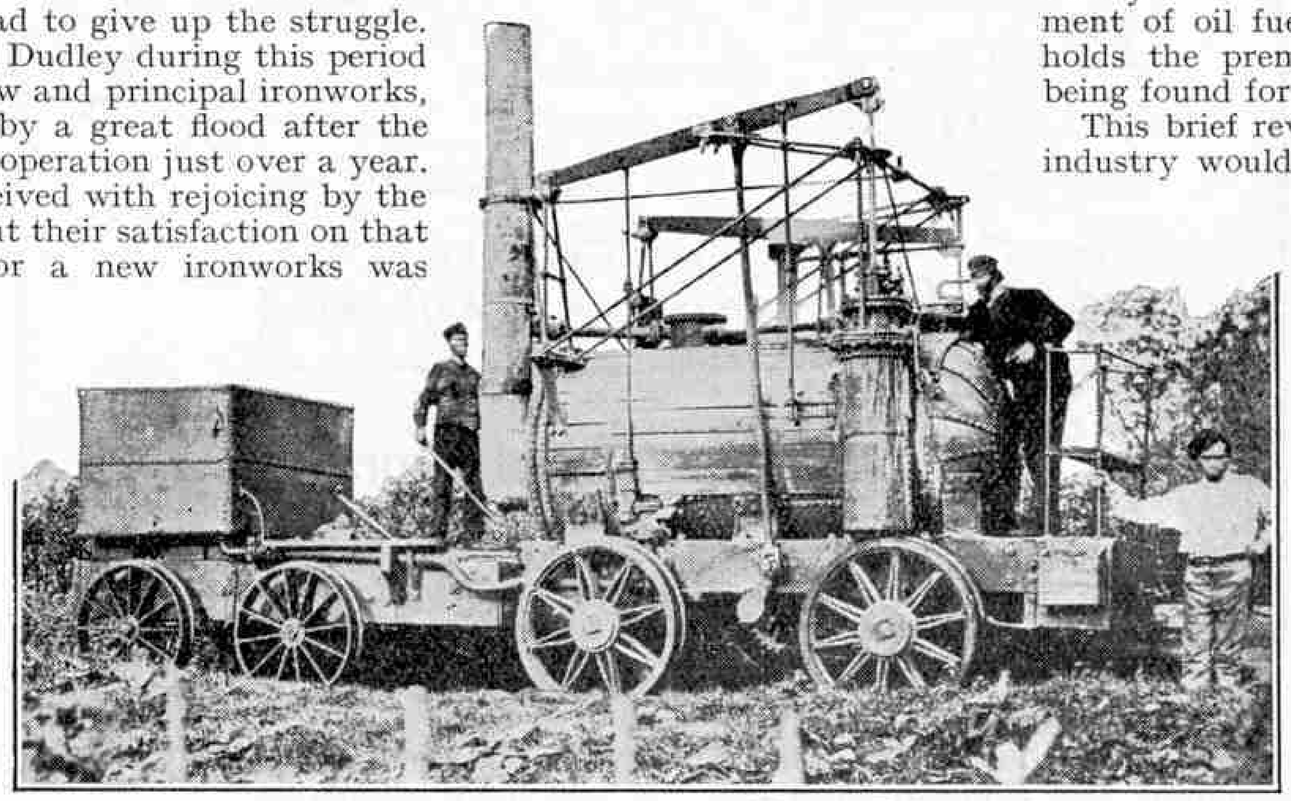
Power and Light from Coal

The steam engine invented by Thomas Savery in 1698 created another important use for coal. Savery's invention was speedily improved upon and rendered more practicable by Thomas Newcomen, whose pumping engines were installed in various coal mines to clear the water out of the workings. Thus coal-burning engines were used to enable more coal to be won. The modest coal-mining industry of that time no doubt benefited by the fact that the Newcomen engine had a tremendous appetite! This "greediness," however, made the engines very expensive to work in other than coal mines, and eventually James Watt's more economical steam engine displaced the other. When at length Watt successfully adapted his engine to perform useful work in breweries, forges and elsewhere, in addition to pumping water out of mines, the importance and need of coal was still further emphasised.

By the close of the eighteenth century coal had become recognised and established as a source of power as well as of heat, and the next century was but two years old when William Murdock astonished the world by illuminating the front of Boulton and Watt's Soho Works, Birmingham, by coal gas, thereby proving the remarkable mineral to be also a source of light.

The years that followed Murdock's introduction of coal gas saw the advent of the steam locomotive and the development of the coal burning ocean-going liner. These new and substantial demands for coal promoted it to a unique place among the world's minerals, and it has aptly been spoken of as the "father of industry." Even with the recent rapid development of oil fuel and water power, coal still holds the premier place, and new uses are being found for it as old ones lapse.

This brief review of the history of the coal industry would be incomplete without some reference to the interesting circumstances in which some of the discoveries of coal in the United States of America have been made. The first discovery of this mineral was made by a boy in Virginia State, who one day in the year 1760 came across an outcrop of coal while he was in search of bait for fishing.



A famous engine, "Puffing Billy," built (in 1813) by William Hedley, for hauling coals from the mine to the staithes near Newcastle-on-Tyne

A Hunter's Discovery

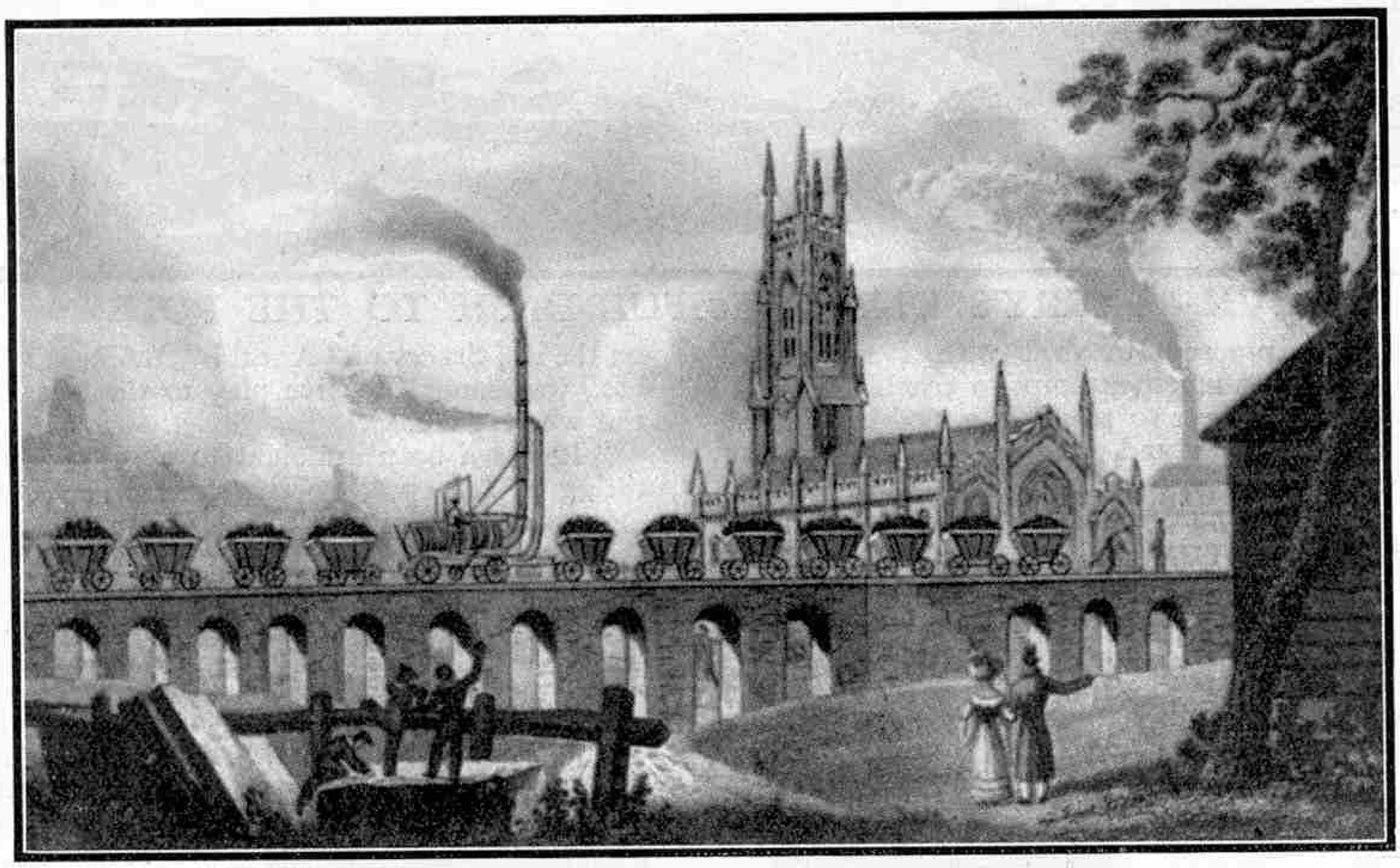
Thirty-one years later anthracite deposits were located along the Lehigh River by a hunter named Philip Ginther. Ginther's dramatic find was by mere chance, and the incident as recorded by Mr. Homer Greene in his book "*Coal and the Coal Mines*" is worthy of repetition. Mr. Greene writes of the hunter :—

"He said that at one time the supply of food in his cabin chanced to run out, and he started into the woods with his gun in quest of something which should satisfy the hunger of those who were at

home. It was a most unsuccessful expedition. The morning passed, the afternoon went by, night approached, but his game-bag was still empty. He was tired, hungry and sadly disappointed. A drizzling rain set in as he started homeward again across the Mauch Chunk Mountain. Darkness was rapidly coming on, and despondency filled his mind as he thought of the expectant faces of little ones at home to whom he was returning empty-handed.

"Making his way slowly through the thick, wet undergrowth, and still looking about him, if perchance something in the way of game might yet come within the range of his gun, his foot happened to strike a hard substance which rolled away before him. He looked down at it, and then bent over and picked it up, and saw by the deepening twilight that it was black."

Ginther knew of the local tradition that stone coal existed in the Lehigh River region, and wondered if he had actually found a sample of the mineral. Taking the black lump home with him, he next day "set out with it to find Colonel Jacob Weiss at Fort Allan, to whom he exhibited what he had found. Colonel Weiss became deeply interested in the matter, and brought the specimen to Philadelphia, where he submitted it to the inspection of John Nicholson, Michael Hillegas and Charles Cist."



A quaint colliery engine at work at Leeds in 1812. Built by Matthew Murray to the design of John Blenkinsop, the loco was propelled by a toothed-wheel engaging in a rack alongside the rails and hauled coals from the Middleton Collieries to the riverside for shipment

When these gentlemen had satisfied themselves that the black lump was undoubtedly anthracite coal, the Colonel was authorised to bargain with Ginther and persuade him to reveal the exact location of his discovery. Weiss thereupon sought out and interviewed the hunter, and on the Colonel undertaking to negotiate with the State in respect to a certain piece of land greatly desired by Ginther, the latter told all that he knew regarding the stone coal.

When anthracite mining at Lehigh River was started up, several years later, the new commodity proved extremely unpopular, and the utmost difficulty was experienced in marketing it. For instance, of six barges of anthracite sent from Mauch Chunk to Philadelphia by way of the Lehigh River in 1803, four were upset on the way, and when the other two loads reached the city no one could be induced to purchase.

Anthracite Refuses to Burn !

The mineowners knew that the great difficulty experienced by citizens in getting the stone coal to burn was due solely to their being familiar only with soft bituminous coals, which responded briskly to pokings and jabbings when in the grate, whereas anthracite resented such interference and declined to burn. The two undesired loads were offered by the owners to the city authorities who, however, soon proved themselves as ignorant as the general public as to the proper treatment of anthracite. Their trial of the new fuel was made in a steam engine and was a complete failure, the coal refusing to burn. The authorities thereupon promptly made an end of the matter by using the remainder of the fuel in lieu of gravel for the city footpaths !

This was too much for the hopeful mineowners and the anthracite mines lay idle for more than nine years before any further efforts were made to convince the citizens of Philadelphia that the coal of Mauch Chunk was a useful fuel. Then one day the city heard of anthracite again. Leaflets telling how the coal should be treated in the factory furnace and the domestic grate suddenly appeared ; a barge of the coal arrived once more at the wharf and was unshipped ; blacksmiths' forges were supplied with the fuel free of charge ; fires were lit free in people's houses and public exhibitions of stoves burning anthracite were organised. The coal of Mauch Chunk at last began to sell and gradually became popular as people learned how to burn it, but those who ignored the advice of the mine-owners and others, and strove to burn stone coal as they did ordinary coal, gave themselves much trouble.

Greene, in his book we have quoted from, relates a typical case :— A firm of wire manufacturers, on hearing of another concern having used the coal successfully, bought a trial lot. In the furnace the anthracite was fed on to a wood fire, but although the furnacemen urged the coal to burn by every dodge they knew, the whole cartload was wasted without any satisfactory result being obtained. Determined not to be outdone by other people, the firm purchased a second cartload and another attempt was made by the men to burn the unfamiliar fuel. Everyone was very grim and had resolved that the mysterious fuel should not defeat them a second time. So hour after hour the furnacemen raked, pushed and poked. Fresh supplies of wood were fed under the obstinate coal, but all to no good.

Throughout the night the men laboured, but when morning came the anthracite was still stubborn. At last the grim, hot task was abandoned, the furnace door closed with a bang, and a group of tired and annoyed men trailed off to breakfast. A little later one of the toilers went back to the furnace room for a jacket he had left there, and on looking at the furnace he was amazed to see that the door was red hot ! Hastily opening it he saw the obstinate coal aglow with intense heat.

His excitement soon conveyed itself to the others, and after the first shock of surprise they set to work and four lots of metal were heated and rolled before any further fuel was added. Further experiment soon convinced them that all the Mauch Chunk stone coal required was to be thrown upon the bed of ignited wood and permitted to burn undisturbed, allowing the steady draught of air to effect combustion.

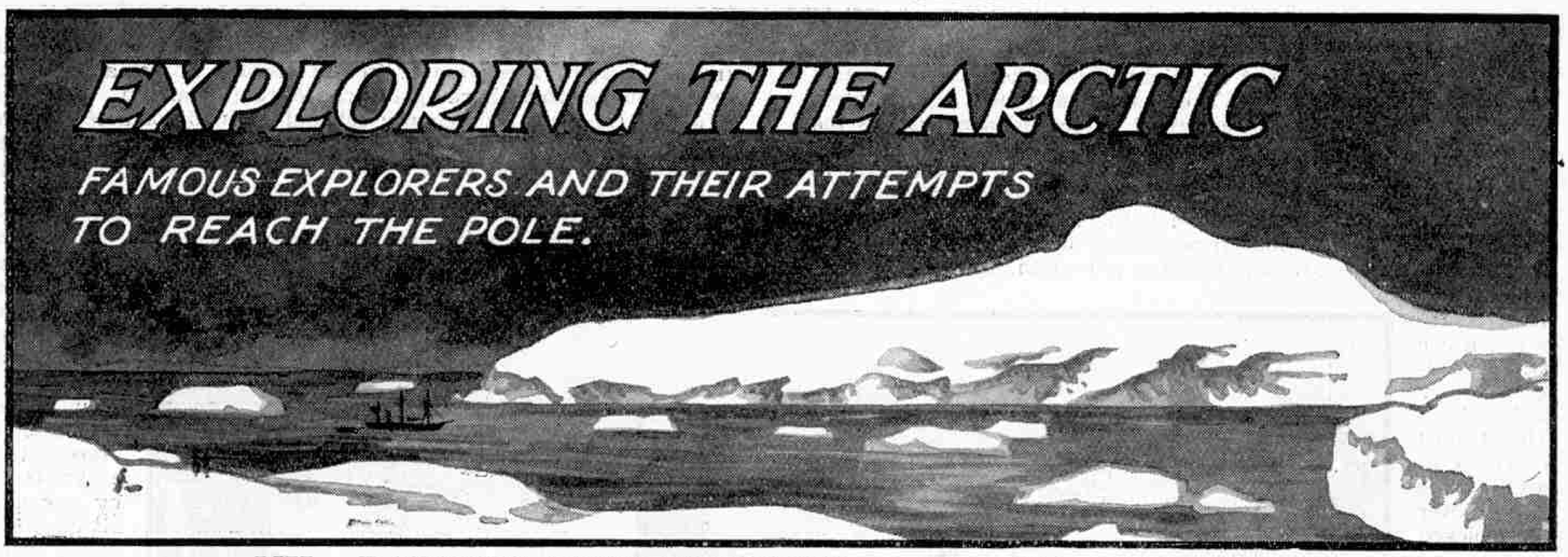
The greatly increased demand for coal that arose in this country following upon the advent of the steam engine and coal gas resulted in innumerable borings being made and many new coal mines opened up. Coal was not always located by the optimistic prospectors, however, and sometimes a search for new deposits would be abandoned after many deep holes had been bored in vain and much money thereby lost.

Much Ado About Nothing

Of these unsuccessful ventures none is more remarkable than that of the Northampton Union Coal and Mining Company. The formation of this company in 1836 with a subscribed capital of £18,000 was the outcome of a report by two experienced miners from Staffordshire that coal as good as any in the country was obtainable within one-and-a-half miles of Northampton.

An interesting account of this venture is given in Vol. II of *"Annals of Coal Mining and the Coal Trade,"* by Robert Galloway, from which we extract the following :—

"A tract of land was leased, men were engaged from the coal countries, and sinking commenced ; and in the spring of 1837 a large steam engine was erected, which (*Continued on page* 265)



VII.—PARRY'S UNSUCCESSFUL DASH TO THE POLE

BEFORE we proceed to deal with Parry's final voyage, and his heroic attempt to reach the Pole, it will be of interest to mention a sledge journey, made by George F. Lyon and some Eskimos. Lyon was a naval officer who served with Parry from 1820-4, commanding the "*Hecla*" on the occasion of Parry's third voyage, when Parry himself was in the "*Fury*."

As fish was wanted for the crews, one of the natives named "Too-le-Mak," agreed to set out on a four days' fishing expedition. Lyon obtained Captain Parry's permission to accompany the Eskimos and went ashore for the purpose. On arriving at the village he was welcomed to Too-le-Mak's tent, where a new deer skin was spread for him on which to spend the night.

The party set off at 10 o'clock on the following morning, on two sledges, one carrying Too-le-Mak and four Eskimos, Lyon and George Dunn—a seaman of the "*Hecla*"—and the second sledge carrying three Eskimo boys. The first sledge was drawn by eleven dogs and the second by eight.

These Eskimo dogs are described as being "large and majestic-looking animals. An old one of peculiar sagacity was placed at the head of the team—by having a longer trace—so as to pick out the safest and dryest places, for the dogs have such a dread of water that they would rather receive severe beatings than swim a foot. The leader was instant in obeying the voice of the driver, who repeatedly called to him by name.

"When the dogs slackened their pace the sight of a seal or bird was sufficient to set them instantly at their full speed, and even though nothing was to be seen on the ice, the cry of "A seal!" "A bear!" "A bird!" etc., was enough to give play to the legs and voices of the whole pack.

"It was a beautiful sight to observe the two sledges racing at full speed to the same object, the dogs and men in full cry and the vehicles splashing through the the holes of water with the velocity and spirit of rival stage coaches!"

Sir W. E. Parry

After about six hours' run over the ice, in weather so thick that the travellers could not see a quarter of a mile in front of them, they came to a number of barren islands of granite, and here they stopped for the night. All the Eskimos lay down in the open to sleep on the rocks, having merely a small piece of skin to keep the rain from their faces. They remained in this comfortless state for eight hours, although it was raining the whole time and was raining next morning when they awoke!

Early next morning they killed a deer, Too-le-Mak lying behind a stone and imitating the deer's peculiar bellow. The animal's curiosity was aroused and in investigating the phenomenon it came within gun shot range, with the result already mentioned.

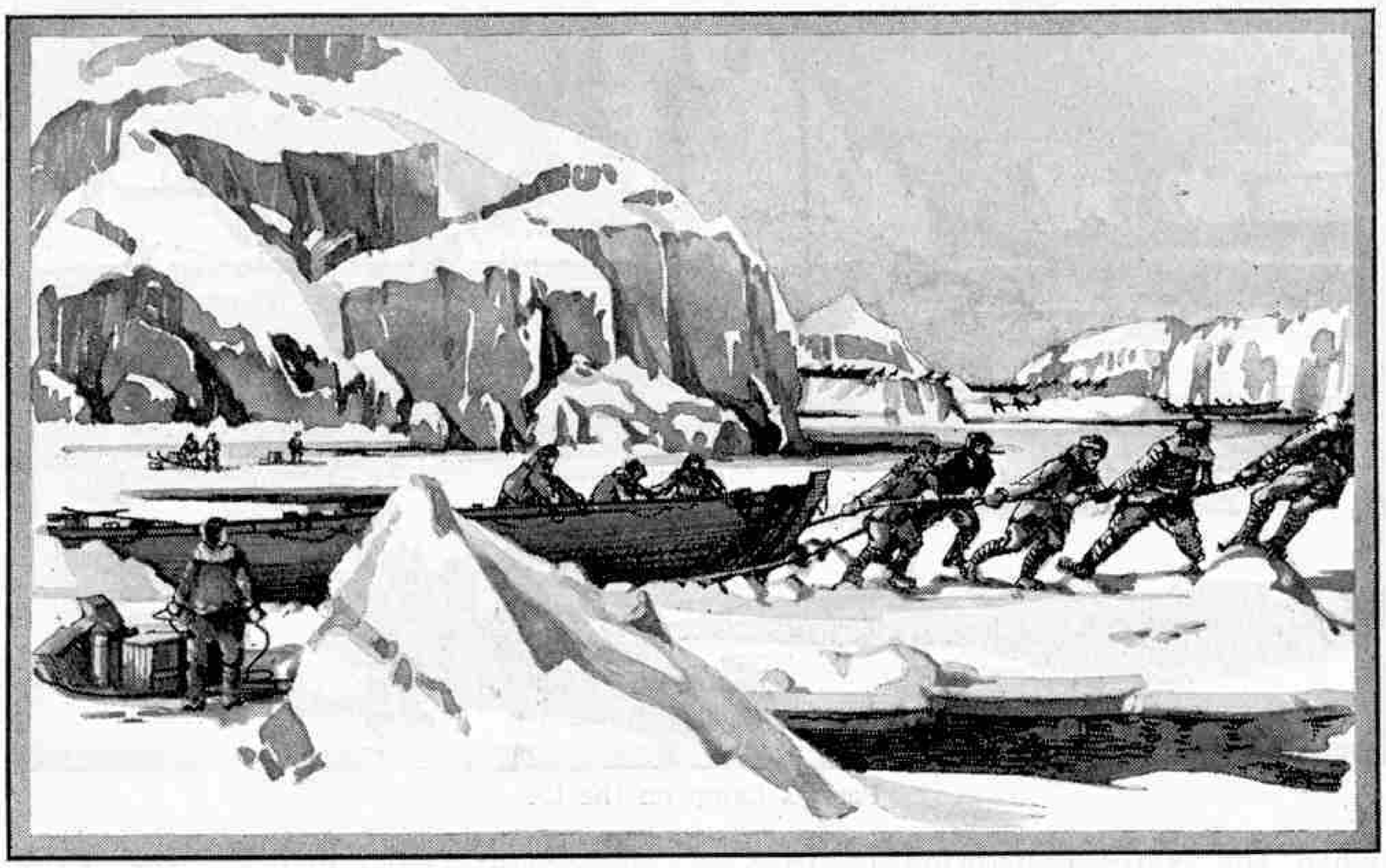
The deer was divided into equal shares and the party "squatted down to a repast . . . and in ten minutes the Eskimos had picked every one of the deer's bones so clean that even the hungry dogs did not attempt to gnaw at them a second time."

On the return journey one of the sledges was upset and broken, and the crew were thrown into a deep hole, receiving a complete ducking. After the sledge had been repaired it was again twice upset. Finally the dogs broke the traces and ran like a pack of wolves

to the land. They were brought back, however, and the party ultimately reached the Eskimo village.

On their arrival here the two Englishmen were joyfully welcomed and awarded the place of honour. "A large assemblage of Eskimos gathered," says Lyon, "to hear me talk . . . and to see us eat!" Later on a native dance and a "Concert" was held in their honour. On the following day they returned to the ship.

In 1827 Parry made his fifth voyage, again in the "*Hecla*," setting sail on the 27th March. In May he was forced to run into the ice, in which he was jammed for three weeks, when he managed to get the ship clear, and sailed to the Seven Islands, situated north of Spitzbergen. On one of these islands, named Walden, he placed a reserve store of provisions, and the ship, having reached Lat. 81° 5′, sailed on to the Hinlopen Strait, where it was to await Parry's return from his attempt to reach the Pole.



Dragging the boats over the ice in a vain attempt to reach the Pole

Parry's idea was to make a dash for the Pole with two boats 20 ft. in length and 7 ft. in beam, which he had designed for the purpose. These boats, each of which weighed nearly a ton, were fitted with steel runners and stood upright on the ice. They were so built that they would have floated even if they had been stove in. This was accomplished by stretching on timber frames casings of waterproof canvas, which acted in a similar manner to balloonettes in an airship. It was Parry's intention that these boats, which were named the "*Enterprize*" and the "*Endeavour*," should be hauled by reindeer. The ice was so rough, however, that this was found to be impracticable with the result that the men hauled the boats themselves.

Lieut. J. C. Ross was in charge of the "*Endeavour*" and Parry himself in charge of the "*Enterprize*." With sufficient food for 70 days, and with equipment (including clothing and light sledges), this gallant band of 26 men dragged the heavy boats over the ice, up and down the hummocks and ridges, surmounting all obstacles, at times waist deep in snow and braving all weathers.

Starting from Little Table Island—where they left a reserve of provisions, as they had done at Walden Island—they went forward through rain and fog, and nothing was allowed to delay them or to turn them aside from their purpose. They travelled by night and slept by day—although, of course, it was daylight all the time.

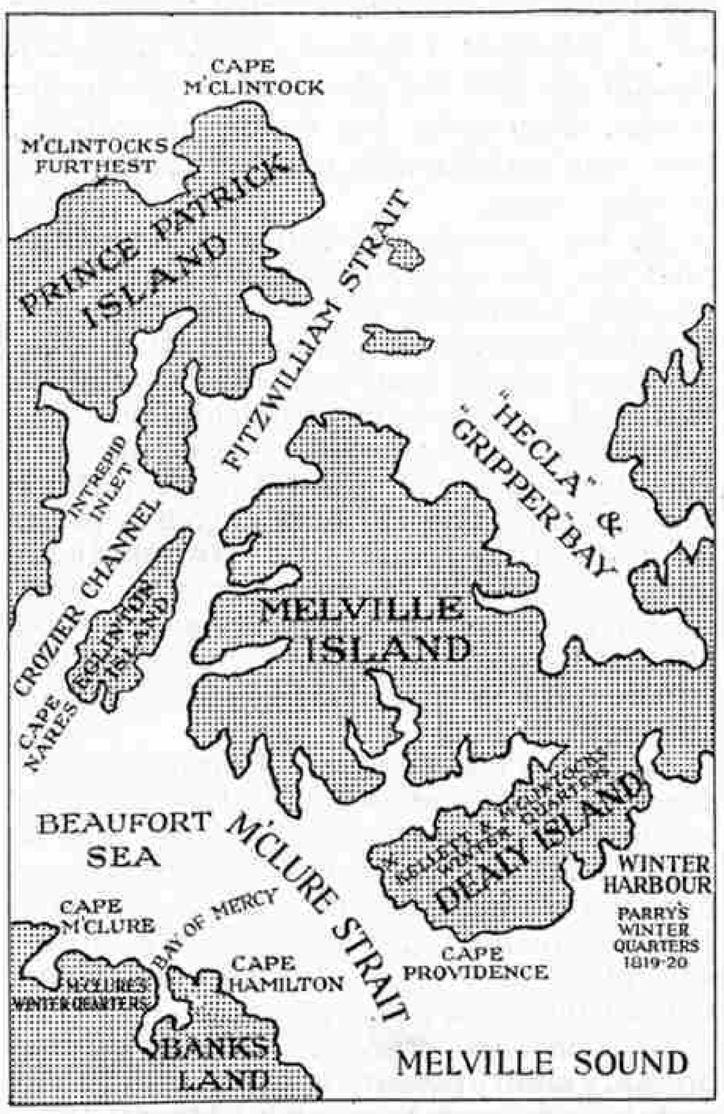
"The advantages of this plan," says Parry, "which was occasionally deranged by circumstances, was in our avoiding the intense and oppressive glare from the snow during the time of the sun's greatest altitude, so as to prevent in some degree the painful inflammation in the eyes called "snow-blindness," common in all snowy countries. We also enjoyed greater warmth during the hours of rest and had a better chance of drying our clothes; besides which no small advantage was derived from the snow being harder at night for travelling.

"When we rose in the evening we commenced our day by prayers, after which we took off our sleeping dresses and put on those for travelling, the former being made of camlet lined with racoon skin, and the latter of strong box cloth. We made a point of always putting on the same stockings and boots for travelling in, whether they had dried during the day or not, and I believe it was only in five or six instances that they were not either still wet or hard frozen."

When the men were resting the boats were placed alongside each other, their sterns turned towards the wind. Sails were supported by bamboo masts and paddles, being arranged over them as awnings.

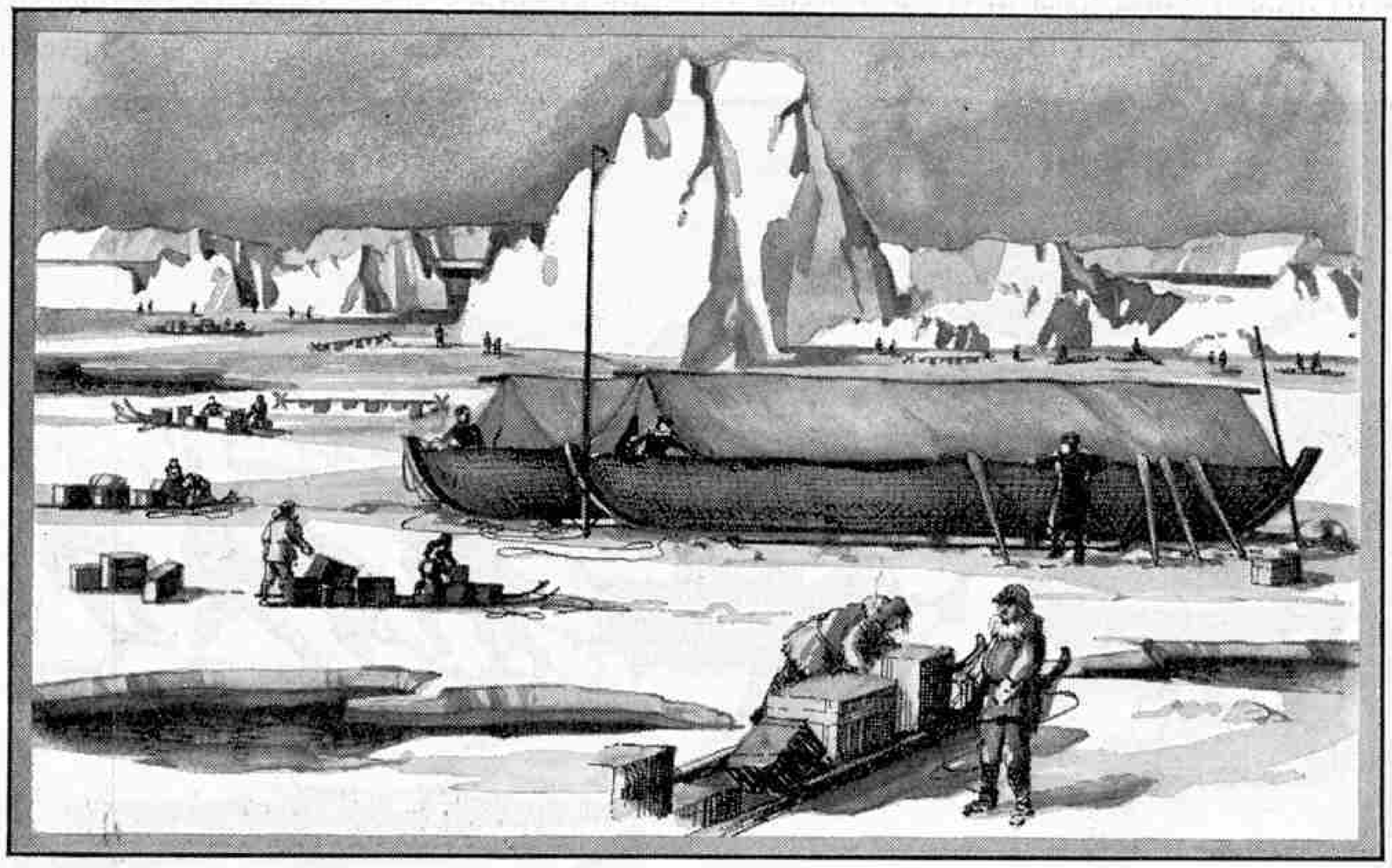
The rate of progress was slow—sometimes only 50 yards an hour and occasionally as much as 12 miles a day when the ice was good. It was not long before Parry found to his dismay, that the distance calculated by reckoning did not agree with that given by observation with the instruments. He was quick to realise that although they were struggling to the north by heroic efforts, their work was in the meantime being made valueless by the fact that the whole of the pack-ice was drifting to the south. Indeed, they were latterly making practically no progress from this reason, and were drifting south by day nearly as far as they marched north by night.

Notwithstanding this, they continued to struggle on until they had



Map showing Parry's Winter Quarters (1819-20) at Winter Harbour

covered 660 miles—a sufficient distance to have enabled them to have reached the Pole had the ice not drifted meanwhile. As Parry tells us in his account: "As we travelled by far the greater part of our distance on the ice, three, and not infrequently, five times over, we may safely multiply the road by $2\frac{1}{2}$; so that our whole distance, on a very moderate calculation, amounted to 580 geographical miles, or 668 statute miles, being nearly sufficient to have reached the Pole in a direct line."



Parry's Camp on the ice

On the 21st July they reached 82° 45′ N. which was the farthest north up to that time—a great feat of endeavour that remained unsurpassed for nearly 50 years, when the Nares expedition in 1875 reached 83° 20′ 26″ N.

After his unsuccessful attempt to reach the Pole, Parry came back to England landing in October and later published an account of his journey in a book called "*A Narrative of the Attempt to Reach the Pole in Boats.*" On the 29th April 1829, he was knighted, Sir John Franklin—whose Arctic explorations we shall deal with later—being knighted on the same occasion.

Parry continued his duties as hydrographer until May 1829, when he went to New South Wales, having been appointed Commissioner to the Australian Agricultural Company. He returned to England in 1835, however, and was appointed assistant Poor Law Commissioner for Norfolk, which position, however, he resigned in a little over a year. Two years later he was engaged in organising the Packet Service—that is the service of steam boats—between Liverpool, Holyhead and Dublin.

For nine years, from 1837, he was Comptroller of the Steam Department of the Navy, and on retiring from active service was appointed Captain Superintendent of the Haslar Hospital. He resigned this office in 1852, however, when he attained the rank of Rear-Admiral and in the following year he was appointed Governor of Greenwich Hospital, which post he retained until his death on the 8th July, 1855.

The Training of Engineers

The question as to the best training for an engineer, always a subject of interest, was raised in a paper read before the North-East Coast Institution of Engineers and Shipbuilders, by Sir Theodore Morison.

The speaker pointed out that there are still to be found a few survivors of the old school, who declare that they will never admit a scientifically-trained man into their works. In this connection, however, it must be mentioned that the pendulum often swings in the other direction, for certain engineers refuse to take pupils who have not already graduated at some technical school or university.

Of course, the value of such qualifications is considerably greater in some branches of the profession than in others. Manufacturers of staple commodities may find their needs fully met by the records of their past experience, but those who are driven by necessity of choice into new fields of enterprise, commonly find that scientific knowledge has a very definite utilitarian value.

In the United Kingdom, it is generally agreed that college training should be backed by shop experience and the arrangement of terms at certain of the Scottish technical schools affords special facilities for this. At Glasgow, for example, the winter sessions are spent at the college and by arrangement with leading firms, students are able to spend the intervening summers in the works, a system that has proved very satisfactory. On the other hand, Sir Theodore mentioned the opinion of a Glasgow engineer, that a youth should go first for six months into some works, then take his degree at college, following up this with another three years in the shops.

At the Armstrong College, Newcastle-on-Tyne, the speaker said, the aim was to provide a training in the principles and theories underlying practice, rather than to spend much time on detailed descriptions of engines and machinery. The laboratories are therefore organised with the object of teaching the student to think for himself. The Honours degree is given only to those taking a post-graduate course, during which in addition to more advanced work on engineering subjects, the student takes up some investigation in the laboratory and assists lecturers in research work.

In this connection, the Editor of "*Engineering*" calls attention to the difficulty of finding subjects for research, the cost of which shall not be prohibitive and points out that chemists are far more favourably situated in this regard, as the only expensive plant they require forms part of the normal laboratory equipment.

Sir Theodore urged the claims of the ordinary shop apprentice, pointing out that certain boys were born with a special aptitude for engineering, and that first-class ability was not so common that we could afford to let any of it run to waste. The boy who came from an elementary school was often handicapped by the standard of general education required for passing the entrance examinations to technical colleges and universities. At Armstrong College, accordingly, special provision has been made for the ordinary apprentices educated in the elementary schools. Apprentices of two years' standing are admitted to the College courses on passing an examination in which the language test is restricted to a translation into English of a passage from a scientific work, whilst their knowledge of English is tested by means of an essay and a *precis*. Moreover, apprentices of two years' standing are allowed to take the first B.Sc. examination as external students, and if a candidate can also pass, as an external student, the second B.Sc. examination, he can get the Honours degree in two years.

The "Lord Nelson" Locomotive

In our account last month of the new Southern Railway 4–4–0 type locomotives, we mentioned (on page 183) that the "wheels are 19½ in. in diameter." This was a slip of the pen and the measurement should have referred to the cylinders, which would probably be inferred by most of our readers for the sentence continued "and the stroke 26 in."

There is also an error on page 99 where the "Lord Nelson" on its trial trip is stated to have covered 83.8 miles in 89.25 secs. instead of 89.25 mins. Major Seagrave and Captain Malcolm Campbell will have to look to their laurels!

Famous Trains

and the Routes over which they run

by

CECIL. J. ALLEN. M.Inst. T. Etc.

III.—THE "WEST COAST POSTAL," L.M.S.R.

POSSIBLY you have never been tempted to wonder how the letter that lies on your breakfast table in the morning has pursued its journey. Or you, on your part, may have written a letter overnight, addressed it to some distant destination, and put it in the post, with never a thought as to how it is going to get there. So it may be that a trip on the famous "West Coast Postal" will awaken a new interest in the travels of your correspondence, conducted with a regularity and a certainty that in themselves are sufficient to explain the small thought that you ever give to the matter.

Travelling Post Offices

Without the "travelling post offices" that now traverse the country in all directions it probably would be impossible to cope properly with the nation's correspondence. Obviously every town or village could not make up a mailbag for every other town or village to which it might desire to send letters or parcels, perhaps only in two's or three's. If this were done the service would break down "from sheer weight of canvas," as one writer has picturesquely put it. Neither does the use of large centres for sorting and distribution altogether meet the case, as there is much postal traffic that is too small to justify a direct delivery from town to town. This is where the travelling post office comes in. By collecting up and sorting the batches of letters received at various points during its journey it is able to add together the "driblets" for each particular place until they amount to a respectable total.

Years ago the postal trains, or the "mails," as they were called, were the fastest and most important trains in the country. Passengers were conveyed by them, but often only first-class, or first and second-class travellers, and extra fares were charged for the privilege of using the trains. To-day the postal business has grown to such enormous dimensions that on the chief postal trains the ordinary passenger is neither wanted nor allowed to travel. These trains run exclusively at night, and while they are no longer the fastest expresses in the country—high speed through the night hours being unnecessary in order to ensure delivery of the letters with the morning's post—every attention is concentrated on the maintenance of absolute punctuality.

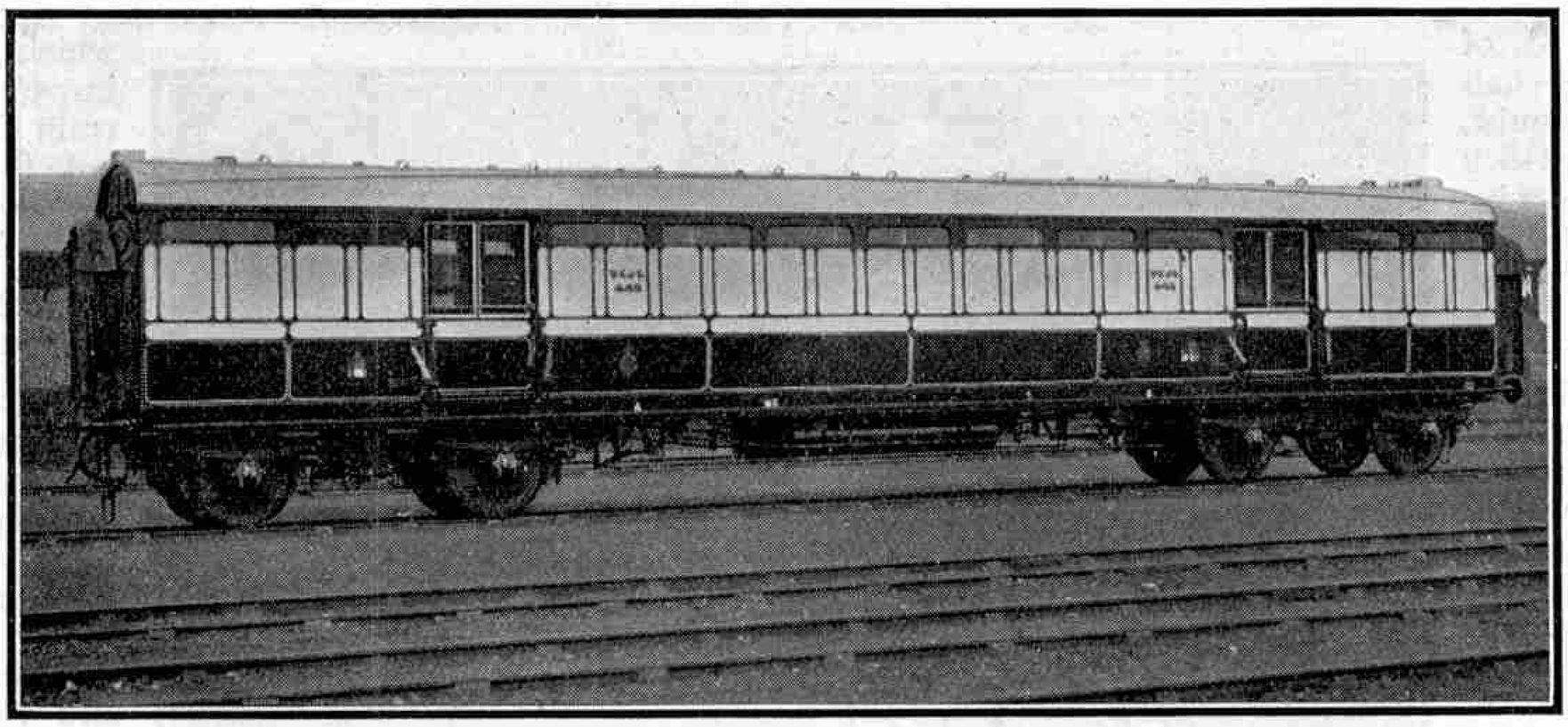


Photo courtesy] **Letter-sorting Van** [*L.M.S.*

Most Famous Postal Train

Most famous, as well as most historic, of all the British postal trains is undoubtedly the "West Coast Postal," which for many years past has left Euston terminus for Scotland, by the L.M.S. route, at half-past eight in the evening. Practically the whole of the mails from London and the South and West of England to Scotland are carried by this train, so that its importance may be readily understood. We are now to imagine that we have secured the jealously-guarded privilege of accompanying the train as passengers, in order that we may see the postal staff at work. The driver, fireman and guard are the only railwaymen on the train, whereas the postal officials number about thirty all told.

Arriving at Euston in imagination at eight o'clock in the evening, we find that the postal staff has been at work for a good hour before us. Drawn up at No. 2 platform, which is paralleled by a wide carriage-way, we see a train of about a dozen vehicles. They include ordinary brake-vans, Post Office letter and parcel sorting

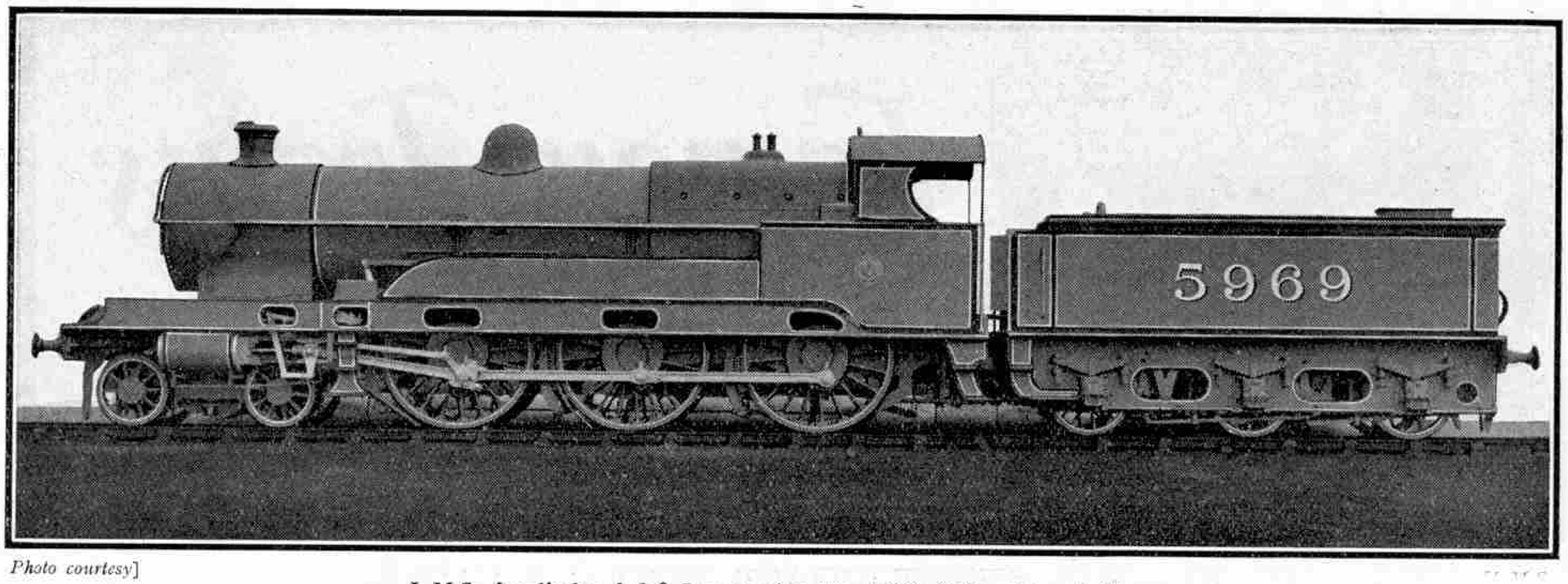


Photo courtesy]

L.M.S. 4-cylinder 4-6-0 Locomotive No. 5969, "Claughton" Class

carriages and "tenders" for stowage, all vestibuled together. Red "Royal Mail" vans of all descriptions are constantly arriving by road from all parts of London, and their contents are being bundled into the different coaches, which are distinguished outside by large and prominent capital letters, according to their destinations. While this is being done, we may have a look at the locomotive.

Engine of the "Claughton" Class

At the head of the train we shall find, without doubt, a 4-cylinder 4–6–0 engine of the "Claughton" class. Very shortly this type is to have a bigger brother, designed with the experience gained from the recent running of the G.W. engine "*Launceston Castle*" over L.M.S. metals. In this connection it is interesting to remember that the advent of No. 2222, "*Sir Gilbert Claughton*," in 1913, immediately followed the similar loan of the G.W.R. "*Polar Star*" in the previous year. Little need be said about the "*Claughtons*"; they are a simple and straightforward design, which has given excellent service in its time, but now needs to be supplemented by something rather more powerful for the maximum duties of the West Coast Route. It is an engine of the "Claughton" class, by the way, that has been fitted with the Italian "*Caprotti*" valve motion, and was recently under test between Euston, Crewe and Carlisle, as mentioned in various newspapers.

But now we must get back to the train, as the departure time is rapidly approaching. At the last moment there come dashing up from the G.P.O. the vans with "late fee" letters and a mass of unsorted correspondence with which there had not been left time to deal at the head office, and which therefore must be added to the work of the officials on the train. Then, when all has been safely "garnered in," the guard's whistle blows, and with a raucous reply from the whistle of the engine we move out on our journey of 540 miles to Aberdeen. We have now ample time before the first stop, Rugby, in which to make our inspection of the train, being careful not to get in the way of the hard-worked "crew."

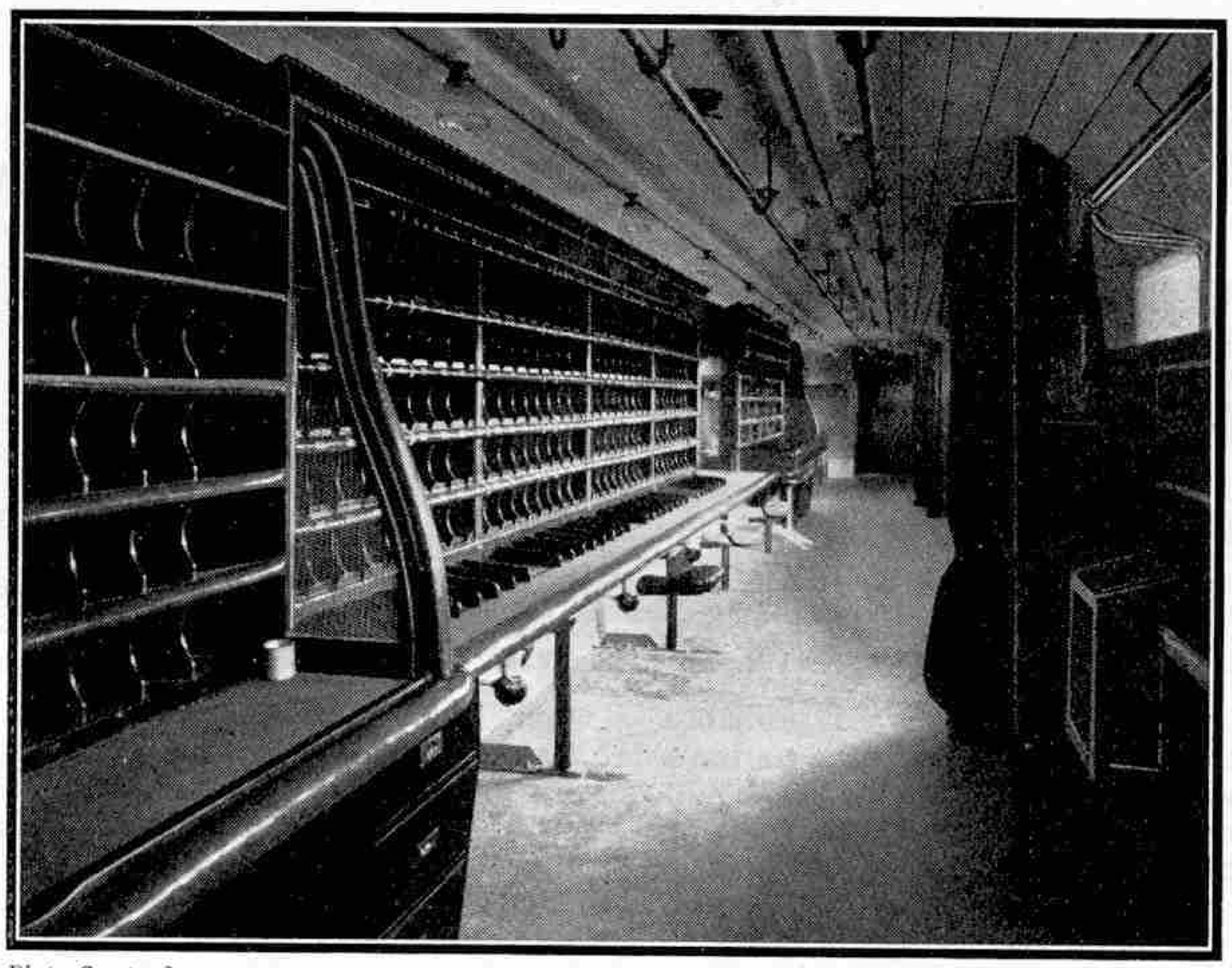


Photo Courtesy] [*L.M.S.*

Letter-sorting Van, interior

Difficult Start out of Euston

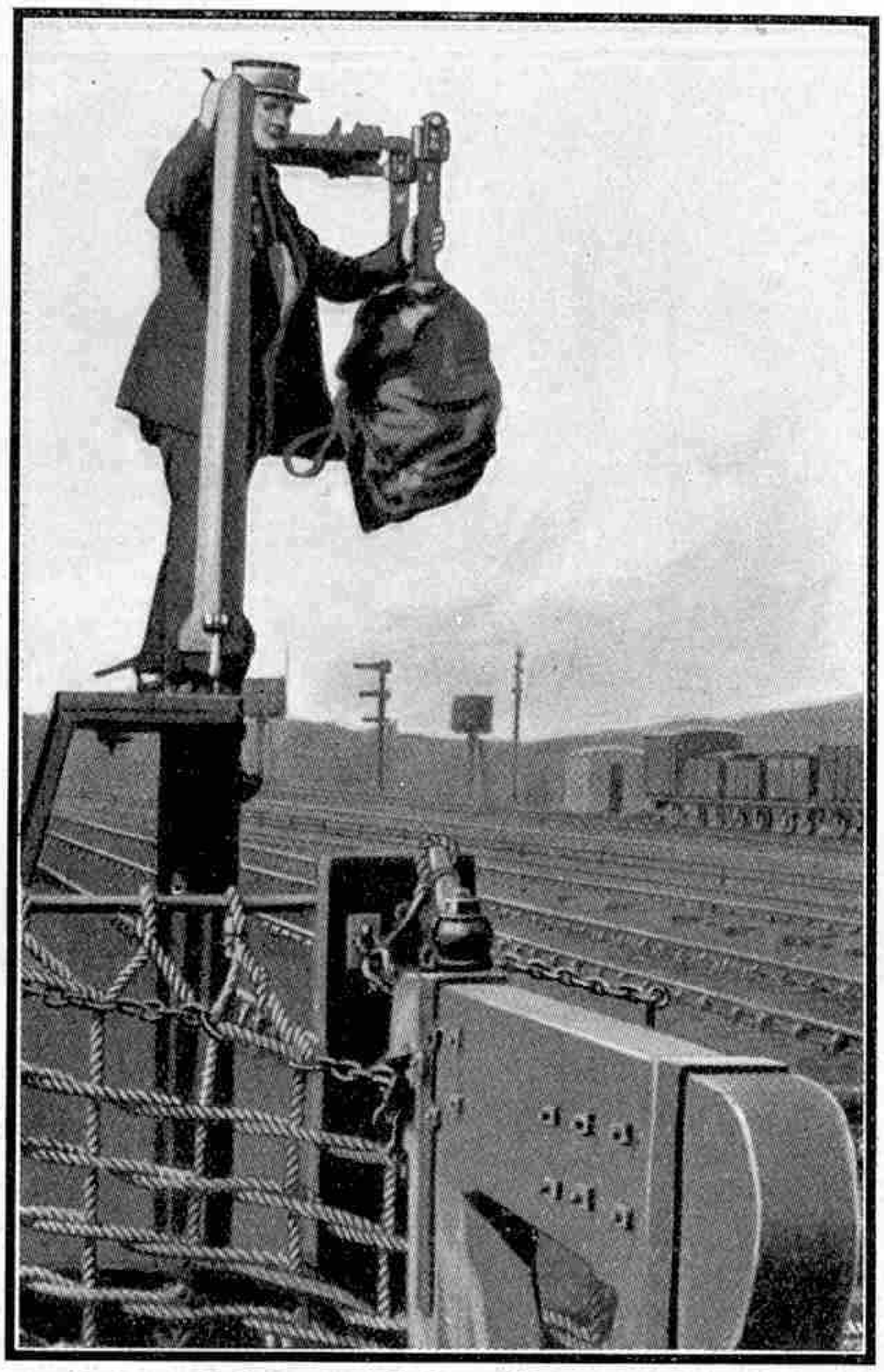
There is a bad start out of Euston, the first $1\frac{1}{4}$ miles to Camden, practically off the platform end, being inclined upwards at between 1 in 70 and 1 in 105. So steep is this bank, indeed, that the engineers of the London and Birmingham Railway never imagined that locomotives would climb it under their own steam, and consequently installed a winding-engine at Camden to haul the trains by rope up the bank, the locomotive to take them on their journey being attached at the summit. Such undignified methods have, of course, been done away with long since, but it is quite possible that the engine that brought in our empty coaches may assist by giving us a friendly push in rear up to the top.

After that there are few grades worthy of mention for the next 180 miles or so; in fact the "ruling," or maximum grade, does not exceed the modest figure of

1 in 330 for some 150 miles continuously. Roughly the line is level from Camden to beyond Willesden; rises from there to Tring, 31¾ miles out, where the Chiltern Hills are crossed at an altitude almost exactly level with the top of St. Paul's Cathedral; drops to Bletchley and Wolverton; rises to Kilsby Tunnel, and falls to Rugby.

Sorting the Letters

Having noted that our engine has got well and truly under way, and as, perhaps, the lights of Willesden Junction flash by, ten minutes after the start, our speed now closely approaching the mile-a-minute rate, we gravitate to that hive of industry—or rather one of them—a letter-sorting carriage. All down one side of the long open vehicle are nests of pigeon-holes for the letters and racks for the parcels, into which the packets are disappearing from the hands of the row of sorters with lightning rapidity. The average rate of sorting per man is somewhere about 40 to 50 letters a minute, but it may vary from 30 to as many as 70, according to the worker's mental and physical condition. Tremendous mental concentration is necessary, especially as the pigeon-holes are not named, but only numbered, and the meaning of each number is constantly changing, according as fresh sets of towns require to be prepared for on successive stages of the journey.



Postman fixing a pouch in position to be picked up by mail train

Needless to say, in the construction of these vehicles special attention is paid to the springing, in order that they may ride as smoothly as possible. Another very necessary precaution is the padding of the ends of the coaches, as well as all projecting angles and corners inside, in case any of the sorters should lose his balance owing to the rocking of the train. Efficient lighting, too, is a matter of supreme importance. The interior of the sorting-carriage is the very embodiment of the proverb "a place for everything and everything in its place," and, feeling as we do that it is certainly no place for us, we move on into the coach in which the receiving and delivering apparatus is worked.

By now we have climbed up to Tring, probably sustaining a speed of round about 50 m.p.h. all the way up the long 1 in 330 ascent, the first 31¾ miles having been covered in 41 minutes. Water has been taken from the troughs at Bushey, 15 miles out of Euston, and the first consignments of letters already have been picked up at various points.

All the time that we were watching the sorters, the bags for delivery were getting gradually filled and sealed up—as the overpowering smell of melting wax forbade us to forget—and were being hung up on hooks behind the sorters, in their proper order, ready to be taken to the apparatus. This again is a job requiring no small care and attention, as there are some 400 different bags in use.

An Army of Postmen

Meanwhile, what time we are devouring space at the rate of a mile a minute or more—between Tring and Bletchley we shall probably cross the "seventy" line—a small army of postmen are converging on the railway from various villages and towns, in motors, on bicycles and on foot, in order to exchange the mails with us as we flash by. Their objectives are the fixed sets of mail apparatus that are arranged along the lineside near the various stations where exchanges are made. At each of these points there is a large opening net, made of some of the stoutest rope obtainable, for catching the bags off the train, and also a tall standard on which the postman's bags are hung, in order to be swept into the train. A small hut is erected adjacent to the apparatus, and in this the postman waits until a bell-signal from the nearest signal-box, which he acknowledges, warns him that the "Postal" is approaching.

While waiting, he has been fastening his bags up in stout leather pouches, as no canvas bags would stand the tremendous buffetting that occurs when the exchange is made. On hearing our approach signalled, the postman mounts the steps of the standard and suspends his pouches from it. The pouches hang from a heavy leather thong, an eyeletted hole in which fits over a pin on the end of the standard arm, while a spring catch further secures the pouches from jolting off before the time. This done, a second bell-signal in the hut warns him to swing the pouches out towards the line in readiness.

Meanwhile the man to whom is entrusted the corresponding job on the train has not been idle, and his is by far the more ticklish job of the two, as he has to be familiar with every place at which an exchange is made and to be ready for it. White warning boards are fixed beside the line to indicate the proximity of the ground apparatus. These are of little use at night, however, and the officer on duty has to rely mainly on his sense of hearing, which constant familiarity with the route has sharpened to an abnormal degree.

As we watch, we notice him open the sliding door at the side of the van and draw in the extending arms, in order that he may hang on them the bags now destined for delivery, enclosed, of course, in leather pouches. These are then swung right outwards, the big folding net on the side of the sorting coach is opened, and an automatic bell begins to ring, announcing the imminence

of the exchange.

Making the Exchange

A few moments' suspense, and then—biff!! Two pouches, detached from the ground standard by a strong leather-bound "V"-rope stretched across the mouth of the carriage net, come hurtling in through the doorway and rebound from the opposite wall. A similar contrivance on the ground net has neatly "collared" our bags at the same moment, the exchange probably having been completed while we are travelling at well over 60 miles an hour.

At Bletchley, which we have now passed, the important connections from Oxford, Cambridge, Bedford and other towns result in some twenty bags or so flying in at once, a whole row of ground standards and a special Post Office on the station platform having been installed there to deal with them. Each fresh arrival of the bags is, of course, opened at once, and the contents are in the hands of the sorters in next-to-no-time, so that the work of sorting goes on practically without cessation.

Post Office Letter Van. Sorters at work

We are now threading Kilsby Tunnel—a name of sinister associations to the builders of the old London and Birmingham Railway, whose estimate of £99,000 for its construction was actually swollen to £300,000 before completion, owing to the tapping by the bore of a gigantic underground quicksand, which flooded out the workings with millions of gallons of water.

Wireless Masts at Rugby

Five minutes later we run into Rugby, having covered the 82½ miles from Euston in 95 minutes. Had it been light, we should have been thrilled, as we approached Rugby, by the sight of the forest of 800 ft. steel masts of the vast Government wireless station at Rugby, immediately on the east of the line. The masts of Daventry, whose name is so familiar, also can be seen quite clearly, on the west of the line, between Weedon and Kilsby Tunnel.

At Rugby a brief three minutes suffice to collect the Eastern Counties mail, and at 10.8 p.m. we are off again, the next booked stop being at Tamworth, 110½ miles from Euston. The gradients are still easy, and probably we shall touch 70 m.p.h., or slightly over, as we dash through Nuneaton. Heavy mail business is transacted at Tamworth, a special train from Lincoln having brought to the high level station many bags from that city, and from Nottingham, Derby and the Midlands generally. To transfer this on to the "Postal," at the low level, needs 7 minutes. At 10.47 p.m. we are off again on our journey to Crewe.

During this run, of 57 minutes' duration, we seize the opportunity of taking a peep into one of the parcel vans. Here the spectator is decidedly *de trop*; there is scarcely room, indeed, in which to turn round. The open coach is full of postal baskets of all kinds, and their contents are being rapidly thrown from hand to hand, amid a babel of shouted destinations, until they reach their proper receptacle. "Parcel Post" takes on a new meaning as we view the animated scene.

Crowded 13 minutes at Crewe

At 11.44 p.m., after rattling over points and crossings innumerable, we run into the big junction at Crewe, where an allowance of 13 minutes is none too long in which to do a tremendous amount of work. Bags and baskets pour in from Birmingham and the Black Country, the uttermost limits of the West of England, South and North Wales. Matter for Ireland is transferred into the "Irish Mail," which left Euston 15 minutes behind us.

During this time our train is "examined," and the engine that brought us over the 158 miles from Euston to Crewe is exchanged for another to take us over the 141 miles on to the Border town of Carlisle. Quite likely our new steed will be one of the large 4-cylinder 4–6–0 engines of the Lancashire and Yorkshire Horwich design.

From Crewe northwards the start to Warrington is mostly on falling gradients and we get away rapidly, but between there and Preston, as we thread the Lancashire colliery area, some rather steeper grades are encountered, notably the 1 in 105 out of Wigan, known as Boar's Head bank. An hour's run, however, suffices to bring us into Preston, 51 miles further on, at 12.57 a.m., where a further heavy mail from Liverpool, Manchester and the thriving towns of East Lancashire is taken on board, in exchange for sorted mails destined for E. and N. Lancashire.

The Rise to Shap Summit

The most difficult part of the "Postal's" journey, from the locomotive point of view, now lies ahead. For the first 27¼ miles out of Preston, past Lancaster to Carnforth, the line is practically level, but at the latter station the West Coast track, which has just skirted the shores of Morecambe Bay, practically at sea level, heads straight inland for the mountains of Westmoreland. In the course of the next 31 miles we have to climb to an altitude of 915 ft. above the sea, at Shap Summit. The hardest grades of the ascent are from Milnthorpe, through Oxenholme, to the wayside station of Grayrigg, 11 miles, and then six miles from just before Tebay to Shap. The former finishes with two miles at 1 in 106 and the latter with four miles at 1 in 75.

Should the weather be bad, or the load over 350 tons, and should we not have taken a "pilot" or assisting engine from Preston, we may possibly stop at Tebay for assistance in rear up the steepest part of the climb. If our engine is running well, however, we probably shall tackle the ascent unaided, though we may expect the speed to fall to 20 miles an hour ere we breast the Summit signal-box. Just before Tebay, by the way, as we threaded the deep gorge that is one of the chief scenic attractions in the daytime, we took water from Dillicar troughs—the ninth and last set of troughs on the 299-mile journey from Euston to Carlisle.

On three separate occasions in London and North Western history a world's record has been created by the covering of this distance non-stop, with the aid of these troughs, but there is little likelihood of any such run being instituted as a regular practice, owing to the strain thereby entailed on both locomotive and crew. The recent talk of the newspapers as to running non-stop from Euston to Glasgow is, of course, sheer nonsense, and has no further foundation than the laying down of water-troughs, now proceeding, between Carlisle and Glasgow.

To come back to our "West Coast Postal," which is now flying down the 31-mile descent from Shap, we may expect our highest speed of the journey, if the driver be so minded, somewhere near Clifton, before the slight slowing that takes place through Penrith, or through Calthwaite or Southwaite, a little further on. Quite possibly a maximum speed of 75 to 80 miles an hour will be attained.

Carlisle in the "Small Hours"

At seven minutes to three in the morning—that indefinable period known as the "small hours"—we draw up in the Citadel Station at Carlisle, having covered the difficult 90 miles from Preston in the excellent time of 106 minutes. Our "Western Division" engine is here exchanged for one of the Caledonian section. At one time it would have

(*Continued on page* 244)

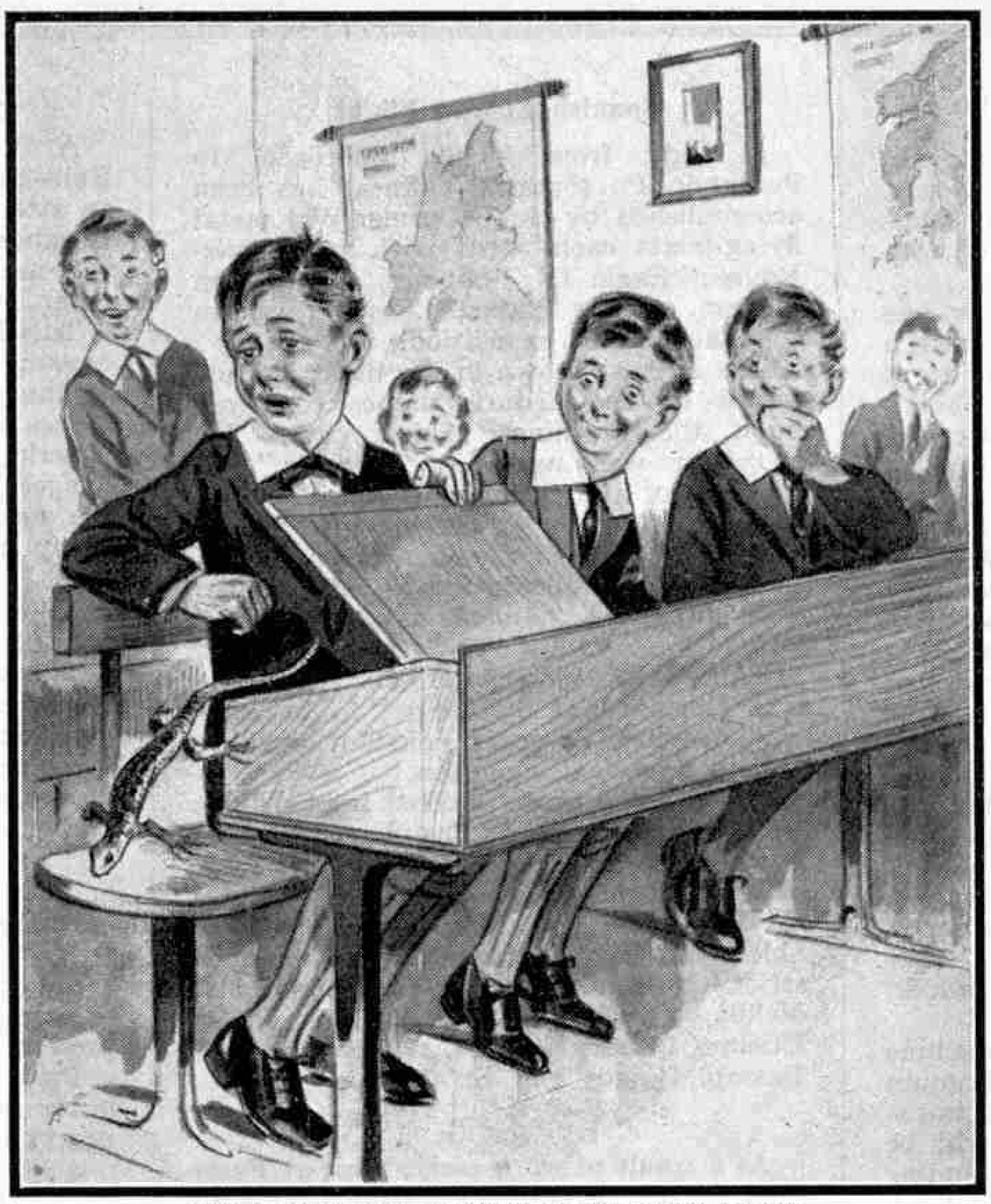
The Scapegoat

A Short School Story, Founded on Fact

WHATEVER happens in school, the blame is always laid on me! This may sound an exaggeration, but it is not so. The other fellows have noticed it and now they always call me the "Scapegoat." If I really were a mischievous chap I would not grumble, but I never start a lark on my own account, I merely join in with the others. I will just tell you one or two things that have happened, and you will see for yourself how misfortune has dogged my footsteps.

We had a new form master about three months ago. His name is Paterson and he is really rather a decent sort. The forms in our class-room are not joined to the desks, and Banks got a screwdriver and drew the screws, so that we could tilt the forms back quite easily. After about three weeks' practice Banks thought we were all in trim, and next morning, when he put his hand to his forehead, we were all to tilt and then try to look very surprised at the result. It worked splendidly, and "Pat" was furious and called out: "Who is playing tricks? If it occurs again I will give him a hundred lines."

I happened to look over in Banks's direction and he looked so innocent that I burst out laughing.



"He gave me such a start that I let go the lizard"

"Pat" pounced on me and said: "You are the culprit, write fifty lines for humbugging in class and two hundred more for moral cowardice."

We did not try seat-tilting again with Mr. Paterson!

One day a chap called Mason came to school with his pockets full of acorns, and Banks thought we could annoy Mr. Paterson splendidly with them. Mason divided the lot amongst us, but would not give me any so that this time I could not get any blame. Well, acorns began flying across the room and "Pat" got very angry, but he could not catch a boy actually at it. I had made up my mind to keep out of this lark, but Banks flicked an acorn right into my hand. No one could have resisted this, so I flicked it back again. Just at that moment "Pat" walked out from his desk and caught me.

There you are again! I had thrown one acorn and got caught, while the others had flicked dozens and got off scot-free. I had to stay in that night and write two hundred lines.

Things were quiet for a time after this, until we discovered that Baxter kept a small green lizard in his desk, and soon everybody in the class had a lizard. We were not allowed to have pets in school at all, but as Banks remarked: "Whoever could call a lizard a pet? It's merely a natural curiosity."

I was the last fellow to get one, and as I was tucking him up in a snug corner of the desk "Pat" yelled out: "Smith, shut your desk." He gave me such a start that I let go the lizard, which wriggled across the floor like greased lightning.

"Whose is this reptile?" said "Pat." "You have broken the rule about pets."

"Please sir, it's not a pet, it's a natural curiosity," said I.

"Go to the Head," cried Mr. Paterson in great wrath. So I got a swishing, and a lecture from the Head on breaking the rule. Neither was very pleasant, and I came out of his study feeling a mere worm. I went to my room and tried to cheer myself up by making little models with my Meccano.

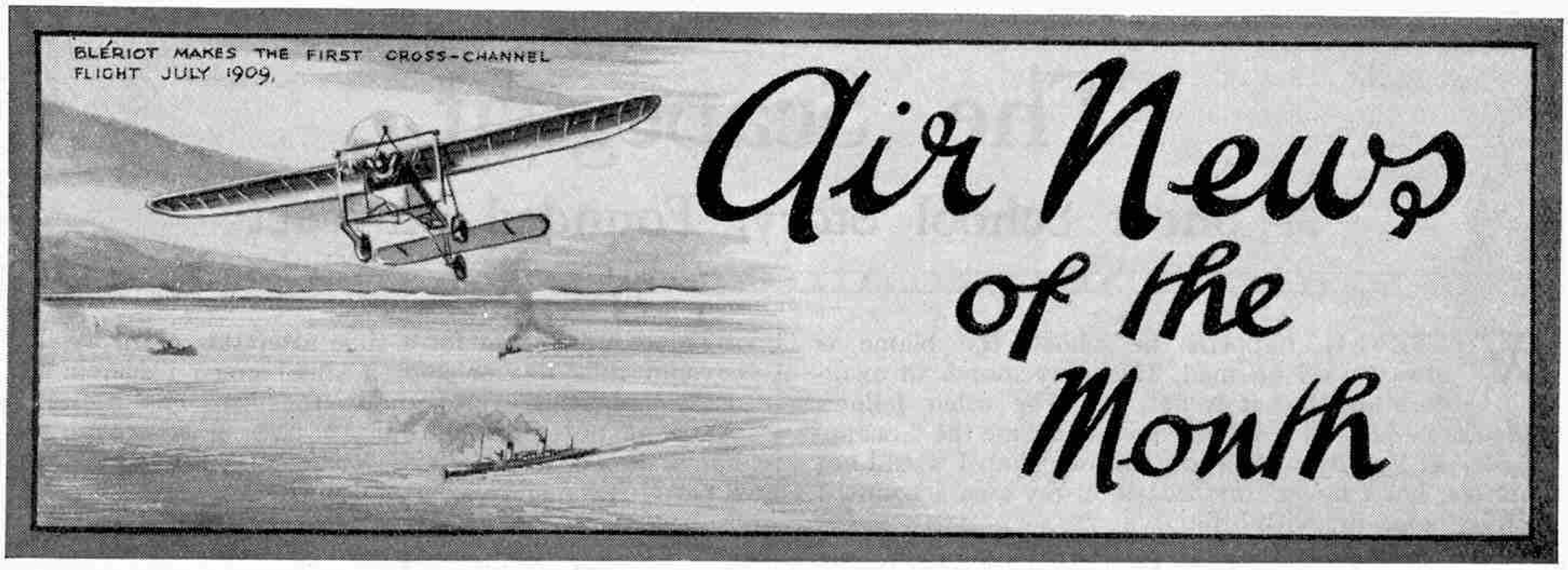
When morning came, however, I was cheerful enough, because on my wardrobe was a real Hornby train which the boys had bought for me. I found out afterwards that they had talked matters over and decided that, seeing that I always got the blame, they ought to make things up to me somehow.

That train could absolutely tear round the track! One evening I decided to try it on a straight track that I laid down the corridor. Away it went to the end of the rails, hopped on to the floor, and dashed right on to the corner. Suddenly, there was a terrific crash. There on the floor, mixed up with my poor old loco was—the Head! He had stepped right on my engine coming round the corner because he was too busy talking to two visitors to look where he was going.

Again I was blamed, but luckily, when he recovered his temper, he said that my carelessness—mine, mark you—had been sufficiently punished by the loss of my loco so soon after it had been given to me.

* * * *

Nothing has happened to me since, but the boys say it is the calm before a storm!



Air News of the Month

The Short "Calcutta" Flying-Boat

The Short "Calcutta" flying-boat, two of which are being constructed by Messrs. Short Brothers for Imperial Airways, has many points of interest in design and construction.

The wing construction is more or less normal and is of the all-metal type with a fabric covering. The hull is built of duralumin, treated by Messrs. Short's special process to protect it against corrosion. It is claimed that the form of construction adopted produces a hull actually lighter than a wooden hull of corresponding size and strength and, of course, there is the additional advantage of freedom from water soakage. There will be comfortable accommodation in the cabin for 15 passengers and owing to the design a particularly unobstructed view will be obtainable from the windows.

Three Bristol "Jupiter" engines will be fitted and will be supplied by gravity feed from two oil tanks housed in the top plane. This arrangement allows passengers to smoke with safety. The cabin will be heated from the engine exhaust pipes. Another interesting feature is that a servo rudder, on the lines of the Flettner rudder, is to be fitted.

The maximum speed of the machine will be about 120 m.p.h. and its maximum range about 545 miles. Wireless transmitting and receiving apparatus will be provided, together with a direction-finding outfit and full navigation equipment.

* * * *

Stalking by Aeroplane

A new aerial sport has been invented by the pilots attached to the Blackburn testing station at Brough, who are using aeroplanes in wild-duck shooting expeditions along the Yorkshire shores of the river Humber.

Two-seater aeroplanes are used for this sport, the passenger carrying a double-barrelled gun. The machines are taken up to about 900 ft., there intercepting the wild ducks as they fly in V-formation from their feeding grounds. The ducks, on finding that a machine is overtaking them, wait until it is a few yards behind and then, wheeling in their flight, fly round the edge of the wings of the machine, thus bringing themselves within range of the passenger, whose task is then easy. The victims are retrieved from the sea as they fall, by a motor-boat waiting for the purpose.

Spanish-African Flight

A flight from Melilla (Morocco) to Fernando Po (Spanish Guinea) has been accomplished by three Dornier-Wal metal flying-boats each fitted with two Rolls-Royce "Eagle IX." engines, arranged in tandem. Major Rafael Llorente was in command of the expedition.

The interest shown in the flight is illustrated by the historic names conferred upon the machines taking part. The squadron was named *"Atlandita,"* in memory of the countries that once connected Europe and Africa before the Straits of Gibraltar joined the Mediterranean and the Atlantic; while the individual machines were christened *"Andalicia," "Cataluna,"* and *"Valencia."* The last-mentioned machine is of special interest. It was the first Dornier-Wal flying-boat to be built and, despite five years' constant work, is still in first-class condition.

The total distance covered in the flight was approximately 4,400 miles, this being flown in nine stages varying in length from 615 to 373 miles. Apart from a delay of six days at Las Palmas owing to unfavourable weather, the stages were covered to strict schedule. The route was as follows :– Melilla, Casablanca, Las Palmas, Port Etienne, Dakar, Konakri, Monravia, Grand Bassam, Lagos and St. Isabel.

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As a result of work carried out at Eastbourne, the Aircraft Operating Company have received permission to style themselves "Contractors to the Ordnance Survey." The Ordnance Survey is the greatest topographical organisation in the world and this formal recognition indicates the value of aeroplanes in surveying large tracts of land.

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Victoria-Tasmania Air Service

The proposed Victoria-Tasmania air service has not yet been inaugurated, and negotiations are still proceeding between the representatives of a flying company and the Governments concerned. At present the two States rely upon a steamer service that takes between 16 and 17 hours, but the air service would reduce this time to three hours for the 300-mile journey. The proposed route is planned to cross the islands in the Bass Strait, thus ensuring that the machines will never be more than 30 miles from land. The possibility of using airships on this route is also under discussion.

German Transatlantic Flight

A Rohrbach flying-boat fitted with Rolls-Royce engines is shortly to make an attempt to fly across the Atlantic from Hamburg to New York. The machine will make two stops on this side of the ocean, one in England and one in Ireland.

This is the first attack on the westerly crossing made by a "heavier-than-air" machine, the previous flights by aeroplanes having been made to Britain from America. In order to guard against the dangers of a forced descent in mid-Atlantic, the machine is to be equipped with emergency masts and sails.

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Earl's Son as Taxi-Driver

Lord Ossulston, heir to the earldom of Tankerville, has purchased a D.H. "Moth" machine and intends to use it for air-taxi work at a charge of 1/– per mile. The machine will be stationed at the Earl of Tankerville's estate at Chillingham, Northumberland.

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First Private Seaplane

A London yachtsman has purchased a D.H. "Moth" seaplane, for use as an aerial yacht. The machine is the first privately-owned seaplane and for the present it will be moored in the Solent.

Private flying is increasing in popularity very rapidly and already there are nearly 100 "Moths" in private ownership.

* * * *

Submarine Aircraft Carriers

Britain, France, Germany and the United States are competing with one another to turn out the first perfect midget seaplane for use from the deck of a submarine. Each country has been experimenting for some time past but very little is known of any of these "vest pocket" aeroplanes.

The American machine is of the portable type and after the floats and wings have been removed it can be stowed away in a steel tube on the submarine's deck. There it remains while the ship is submerged. When the ship comes to the surface, it is barely a five-minute job to bring the machine from its tube, attach the floats and wings and launch it alongside. The seaplane, a single-seater, is fitted with a radio set and carries sufficient fuel for a 500-mile flight.

The range of vision of a submarine on the surface extends over only a few miles, and it is stated that the effectiveness of a submarine carrying a seaplane is increased by more than 100 per cent.

An Interesting Metal Airscrew

A metal airscrew embodying several new features has been constructed by Messrs. Short Bros., of Rochester, and has given good results in trials.

The metal chosen for the new airscrew is duralumin, which combines the desirable features of strength and lightness. The blades are made of separate components, each having a longitudinal slot. On assembly these slots are fitted together and solid blocks of duralumin are inserted to ensure that the correct angle between blades is obtained. The boss is formed by the blocks and the blades themselves, and can be bored for the propeller shaft after assembly is completed. By constructing an airscrew in this manner, the strain found in a one-piece airscrew, due to the necessary twist in the blades, is eliminated. In addition, if one blade of the screw should break it can be replaced, without the necessity of renewing the whole propeller. Furtheradvantagesare that factory production is simplified with a consequent reduction in cost and that transport and storage are made easier.

Trials on a Short "Mussel" seaplane showed that the machine gained 3 m.p.h. on top speed when fitted with one of the new airscrews while there was no falling-off in efficiency at slow forward speeds such as occurs with many airscrews of this type. It was found also that with the metal airscrew the machine would rise in a dead calm with a load 70 lb. greater than was the case with a wooden screw.

* * * *

The Air Route to India

The inauguration of the England-India air route by the flight of Sir Samuel and Lady Maud Hoare was completed on 8th January. The only failure to keep to schedule time occurred on 5th January when, owing to a very severe sandstorm, the aeroplane was forced to return to Jask. When the aeroplane reached Karachi it was christened "*City of Delhi*" by Lady Irwin, wife of the Viceroy of India.

On Wednesday, 12th January, the first scheduled flight eastward along the new route was commenced by a D.H. "Hercules" machine. At present, passengers are carried by air as far as Basra, where they are transferred to fast steamers to complete the journey to Karachi. It is anticipated that from 6th April a regular air service will be operated between Cairo and Karachi, and thus passengers from England will be able to make the complete journey to Karachi by air.

* * * *

This year's Royal Air Force display has been fixed for 2nd July. Exhibitions of high-speed "sky-drill" will be given and expert R.A.F. airmen will demonstrate the latest "stunt" flying.

Flying Prospects in India

It is considered probable that the proposed Rangoon-Calcutta service will become an accomplished fact. The route to be followed has not yet been settled and it is doubtful whether Borneo will be included. Seaplanes are best suited to this route and by their use it should be possible to maintain a regular service.

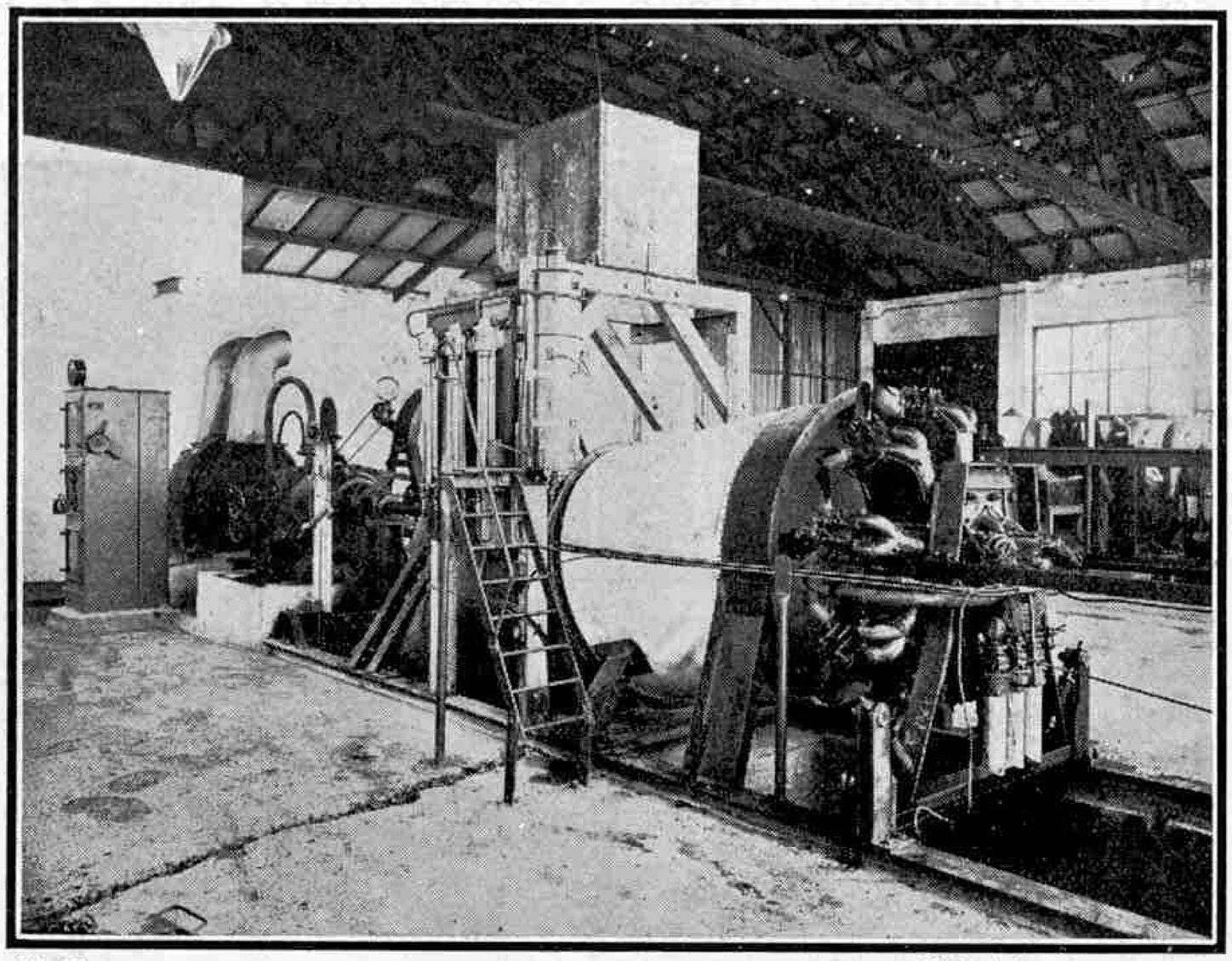


Photo [*Bristol Aeroplane Co. Ltd.*

Testing equipment for Jupiter aero-engines (***see article on next page***)

Cable-Laying by Aeroplane

Swedish engineers have recently carried out the interesting feat of laying and connecting up six miles of emergency telegraph cable in eight minutes, using an aeroplane as cable-layer. One end of the cable was attached to a marker and when the point where the connection was to be made was reached the cable was cut from the reel, weighted and allowed to fall to the ground. The actual laying of the cable took only six minutes, the other two minutes being occupied in making the necessary connections. The success of this experiment suggests a valuable use for aeroplanes during war in restoring telegraphic communications where the cable has been severed.

* * * *

Mooring Masts for Canada and South Africa

The governments of Canada and of the Union of South Africa both have formally requested the assistance of British experts with a view to the erection of airship mooring masts, as recommended by Sir Samuel Hoare at the last Imperial Conference. Expert engineers therefore will visit Canada and South Africa shortly to give advice upon the matter.

* * * *

Air Taxis

A private company under the name of "Air Taxis Ltd." has been formed to hire out aeroplanes for the transport of passengers and goods to any part of Europe and Asia. The cost of the journeys probably will work out at between 1/8 and 2/– per mile.

German Aviation Developments

The fusion of the German air companies into one concern, the Luft Hansa, has created opportunities that have been seized promptly by the organisers of the combine. This year the services are to be extended considerably by the creation of additional home routes in order to feed the widely separated international airways stations. New international airways are to be opened between Germany and Austria and Czecho-Slovakia, and a line from Dantzig to Kalmar will be connected up with Stockholm. In addition a seaplane service will follow the waterway between Cologne and Rotterdam by way of Duisberg and Ruhrort. It has been agreed by the nations concerned that the Berlin-Amsterdam-London service is to be run by the Luft Hansa, while Imperial Airways will operate the London-Cologne service.

A big air port is being formed at Munich and it is intended that ultimately services will be run to Milan, Rome, Barcelona and Madrid by way of Basel and Marseilles, seaplanes being used over the Mediterranean course. In summer the services will be continued from Stettin to Oslo and the Berlin-Moscow line will be connected up with Finland.

* * * *

An Unlucky Flying Man of 1560

Documents have been found in the Kremlin at Moscow showing that, in the year 1560, a Russian named Nikichka made a gliding flight from the top of the cathedral in the presence of Czar Ivan the Terrible, and landed safely on the cathedral square. Nikichka had fitted a pair of wings to his shoulders and he held some kind of parachute, and thus was enabled to make a gentle descent. His feat was hailed by the crowd with loud acclamation as a miracle but the Czar, fearing sorcery, decreed that, "as man is not a bird," the unfortunate airman should be beheaded. This order, sad to relate, was immediately carried out!

* * * *

Light Aeroplanes' Flight to India

A striking demonstration of the reliability of light aeroplanes was afforded by the flight to Karachi recently carried out by Mr. T. Neville Stack and Mr. B. S. Leete.

The airmen left Stag Lane Aerodrome on 15th November last on two standard D.H. Moths, with A.D.C. Cirrus II. engines, and arrived at Karachi on 8th January. No special preparations were made, the airmen landing on whatever aerodromes existed on their line of flight and buying their petrol as they proceeded. Their route included 500 miles of oversea flying and 860 miles across the Syrian Desert from Cairo to Baghdad. This was the first occasion on which civil aviators had crossed this desert.

HOW THINGS ARE MADE—V.

Engines for Aeroplanes

The Bristol "Jupiter" Aero-engine and its Manufacture

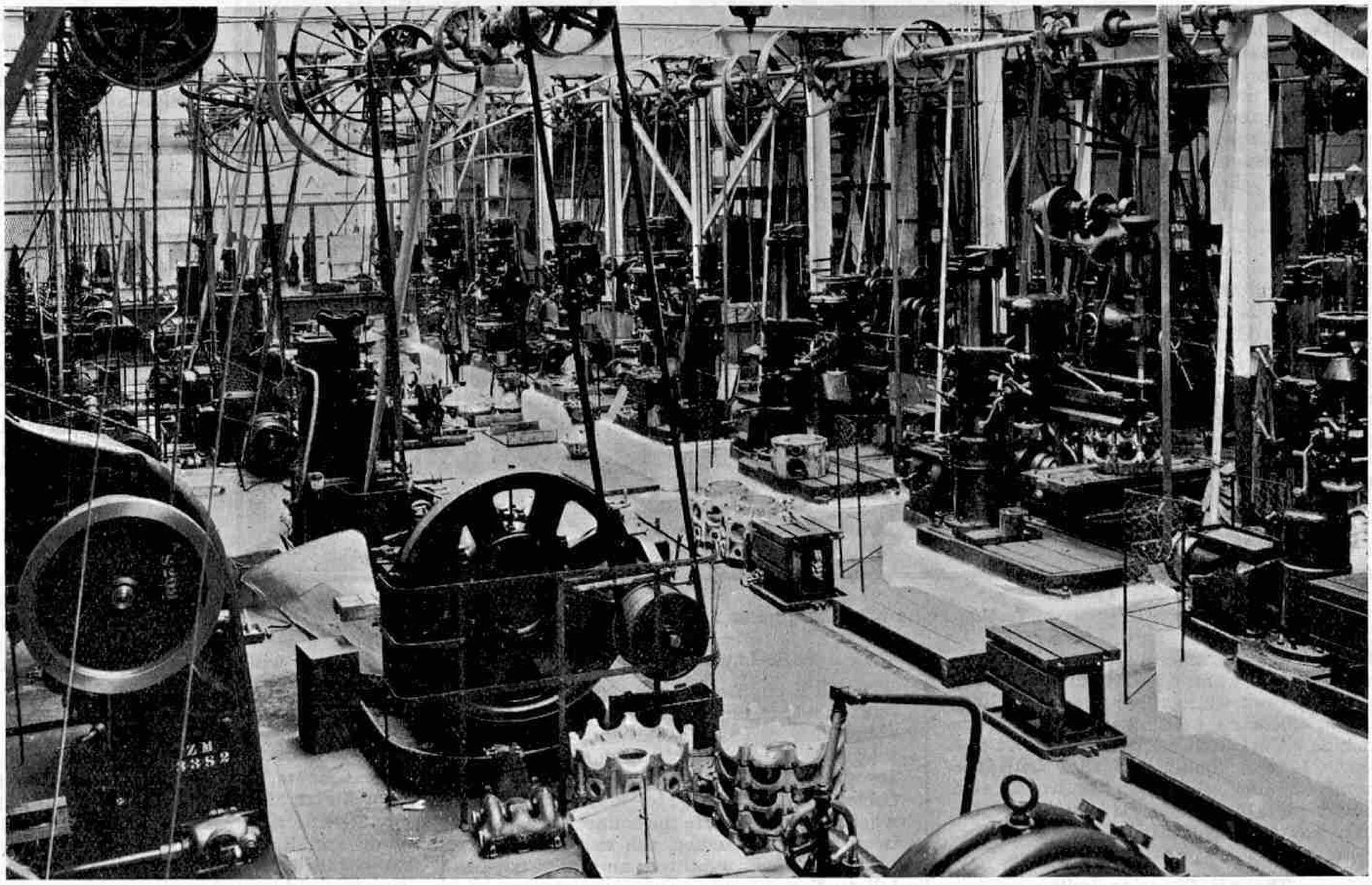


Fig. E. Some of the Vertical and Radial Drilling Machines

IN the first instalment of this article, published last month, we learned something about the design of the Bristol "Jupiter" engine, and considered a few brief details of the layout and equipment of the factory where these engines are made and assembled.

This month our interest lies in some of the technical processes of manufacture, for the machining operations in connection with which a very complete equipment of jigs, tools and gauges has been provided, to ensure a high degree of interchangeability. We have not space to refer to all of these, although many of them are of considerable interest to engineers. We propose, however, briefly to describe a number that we were able to see in use during the course of a recent visit to the works.

Machining the Cylinder Head

Dealing first with the cylinder head, which is an aluminium-alloy casting, the first machining operation is the milling of the inlet and exhaust port faces. The special feature of the jig used for this operation is that it gives the indications for the finished article from the first machining operation.

The casting is set up on three adjustable points, and "eye-glasses" are placed around it in their definite positions. These eye-glasses have holes drilled in them corresponding with the finished positions of the drilled holes in the ports. A cross bar at the top of the jig carries four plungers with scribing points attached, the centres of the plungers corresponding with the holes for the valve guides. By means of the three adjustable points, the casting can be equalised to give the best possible position for the holes.

The head having been clamped in position by the screw, the eye-glasses are removed and the three faces milled with the aid of the indexing gear, the glasses being afterwards replaced so that the holes can be marked roughly. At this stage the viewer can see whether or not the casting will become a waster in the later operations, without checking any dimensions.

It will be understood, of course, that it is impossible to take any fixed point in a casting of this class for use for jig location, as owing to the fact that the amount of metal around the bolt holes and valve-guide holes is

kept to a minimum, some distortion of the casting is inevitable, during the foundry operations.

Drilling, Boring and Milling

The head is next transferred to a turning jig, locating being done from the previously milled surfaces. In this the lower end is faced.

The next operation is the drilling, crowning and recessing of the valve-guide holes, for which purpose the box jig shown in Fig. C (see last month's "*M.M.*") is employed. Location is again from the milled faces, and the tools, a complete set of which is shown, all work to a definite stop on the jig to ensure that all the holes are exactly alike.

The next operations, in order, are the drilling of all the small holes, the boring of the inlet and exhaust ports, the profiling of the head and the milling of the guide jaws on the top. The separate jigs and fixtures used for these operations, however, do not call for special comment.

At this stage the head is passed through the view room to the stores and then to the fitting shop, where it is scruffed all over and the jagged edges removed. It is then heated to 250 deg. C. to shrink in the valve guides. The next machining operation is the reaming of the valve guides, carried out by means of pilot reamers.

The final machining operation is the grinding of the lower face, for which is employed a jig having four expanding plungers fitting into the reamed valve-guide holes. The face of the head is now as flat as it can be finished by machine work, but before the part is ready for erection into the engine this face is bedded to a surface plate and carefully scraped, since excellent contact between the cylinder head and the cylinder body is of the utmost importance.

A multiple-spindle drilling head and jig is employed for drilling and reaming the eight holes in the crank-case for the cylinder holding-down studs. In this each spindle is driven by one large gear mounted on the main drilling machine spindle. The jig is attached to the head and spring loaded so that it is not necessary to clamp it to the crank-case. When the spindle is withdrawn, the jig is withdrawn at the same time. The same head, fitted with another jig, is used for drilling the holes in the cylinder flanges, this operation being shown in Fig. D (see last month's "*M.M.*"), from which the design and arrangement of the head and jig may be followed. One other operation on the crank-case (illustrated in the accompanying Fig F), is the reaming of the cylinder holes. As will be understood from this illustration, the crank-case is bolted on to a faceplate and the holes, previously bored, are finished to exact size by a hand reamer, guided by a rod passing through a hole in a mandrel in the axis of the crank-case and at right angles to the faceplate.

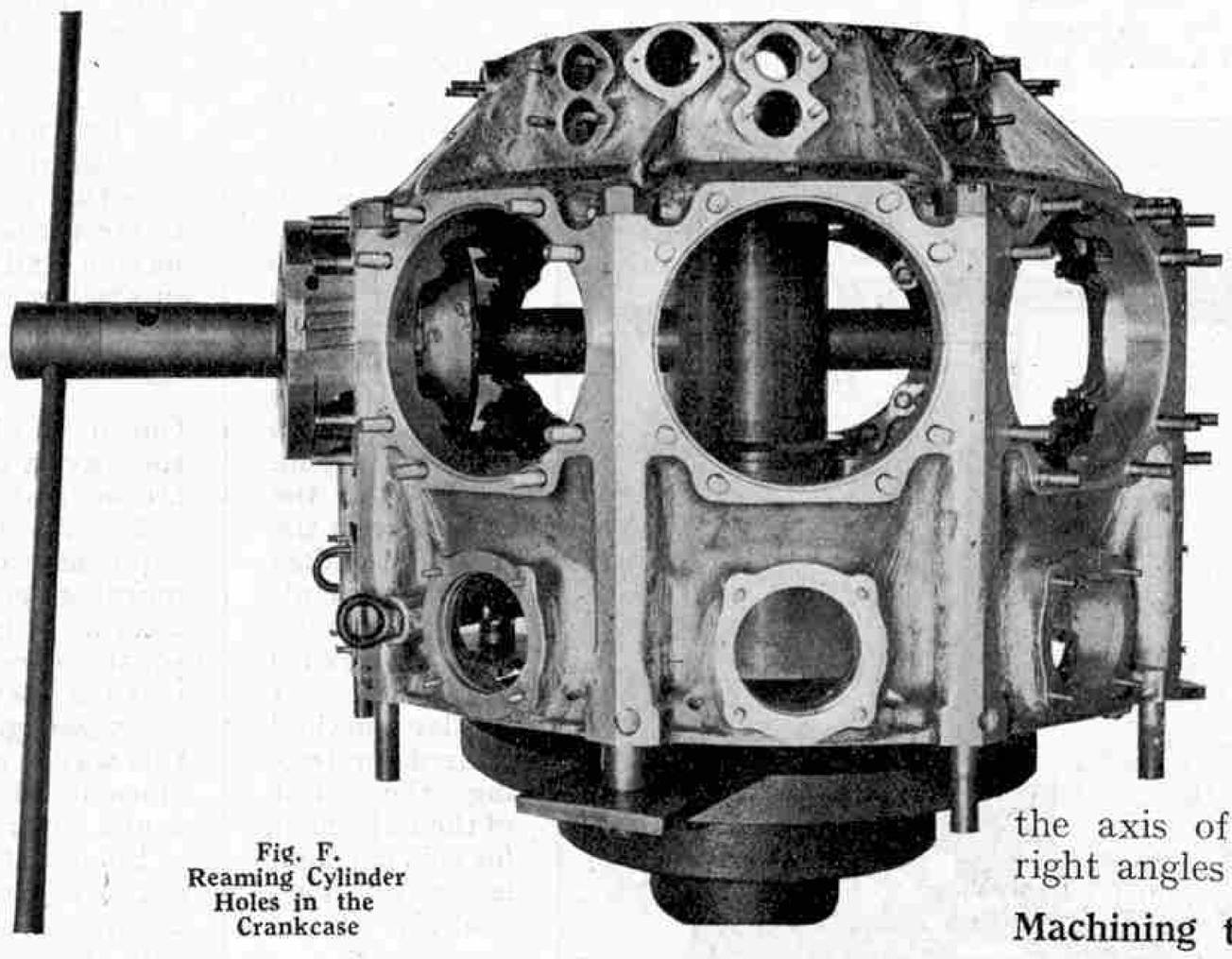


Fig. F. Reaming Cylinder Holes in the Crankcase

Machining the Crankshaft

An interesting operation in connection with the machining of the crankshaft may here be referred to. This is the method of producing the splines on the tapered portion of the shaft, by means of which the torque is transmitted to the propeller hub.

The splines are first rough milled in the ordinary way to within 0.002 in. of the correct depth for the whole of their length and then, at the larger end only, to 0.002 in. below the final depth of the remaining portion. This gives the necessary clearance for the entrance of a stationary form tool, which is held in a special carrier bracket mounted on the arm of the milling machine, as shown in the photograph reproduced in Fig. G on this page. The tool is adjusted to the correct finished depth in one of the splines and the machine table is then traversed by hand to plane out the surplus 0.002 in. of metal left by the milling cutter. By means of the indexing attachment, the other splines are similarly dealt with, and, in this way, they are left with a perfectly smooth finish in which no signs of the cutter traverse can be detected. It is interesting to mention that although, in this work, the splines are not touched by hand, the shaft can always be guaranteed to fit any hub and to give perfect contact over the whole of the surface. This is indeed a remarkable tribute to the great accuracy of the manufacturing processes.

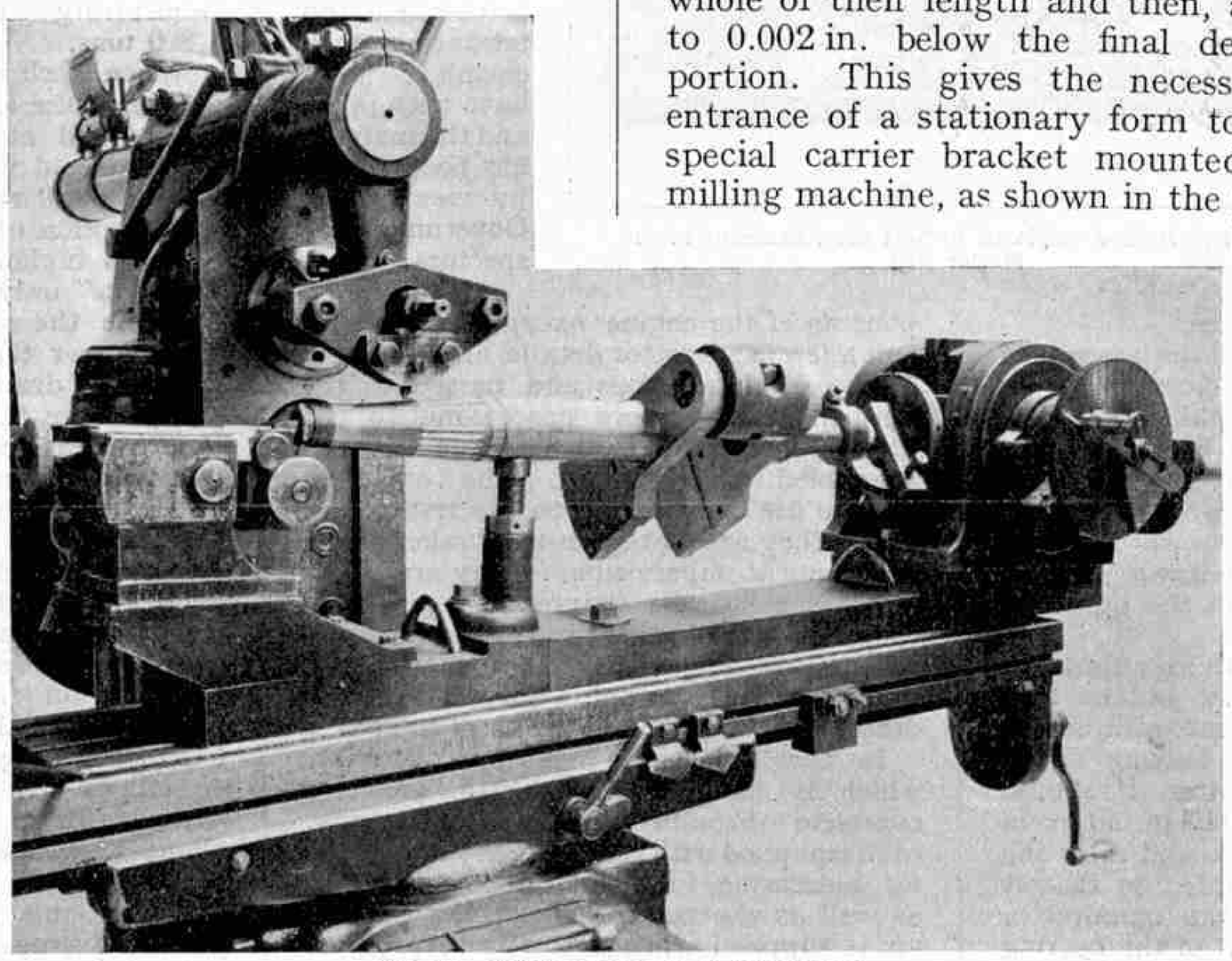


Fig. G. Finishing Splines on Crankshaft

Camshafts are Ground Three Times

In connection with the grinding of the camshaft, which is carried out on a 12 by 36 in. Churchill machine, it may be mentioned that the shafts are ground before carburising, again before hardening, and finally after hardening. These three operations are employed to eliminate grinding cracks, with which trouble previously had been experienced. The grinding before hardening, of course, removes any distortion from the carburising process as well as any machining errors, and in the final grinding operation only about 0.003 in. has to be removed.

Special attention is given to the milling of the flutes in the connecting rods, and no rod is passed that shows any signs of a dig-in or any feed marks in the radii.

Reaming to 0.0005 in.

The four fitting faces on the big-end are machine ground, and hand scraped to a surface plate. In this operation care is taken to secure a slightly heavier bearing on the lugs than on the spigots, no bearing is taken on the radii between these surfaces.

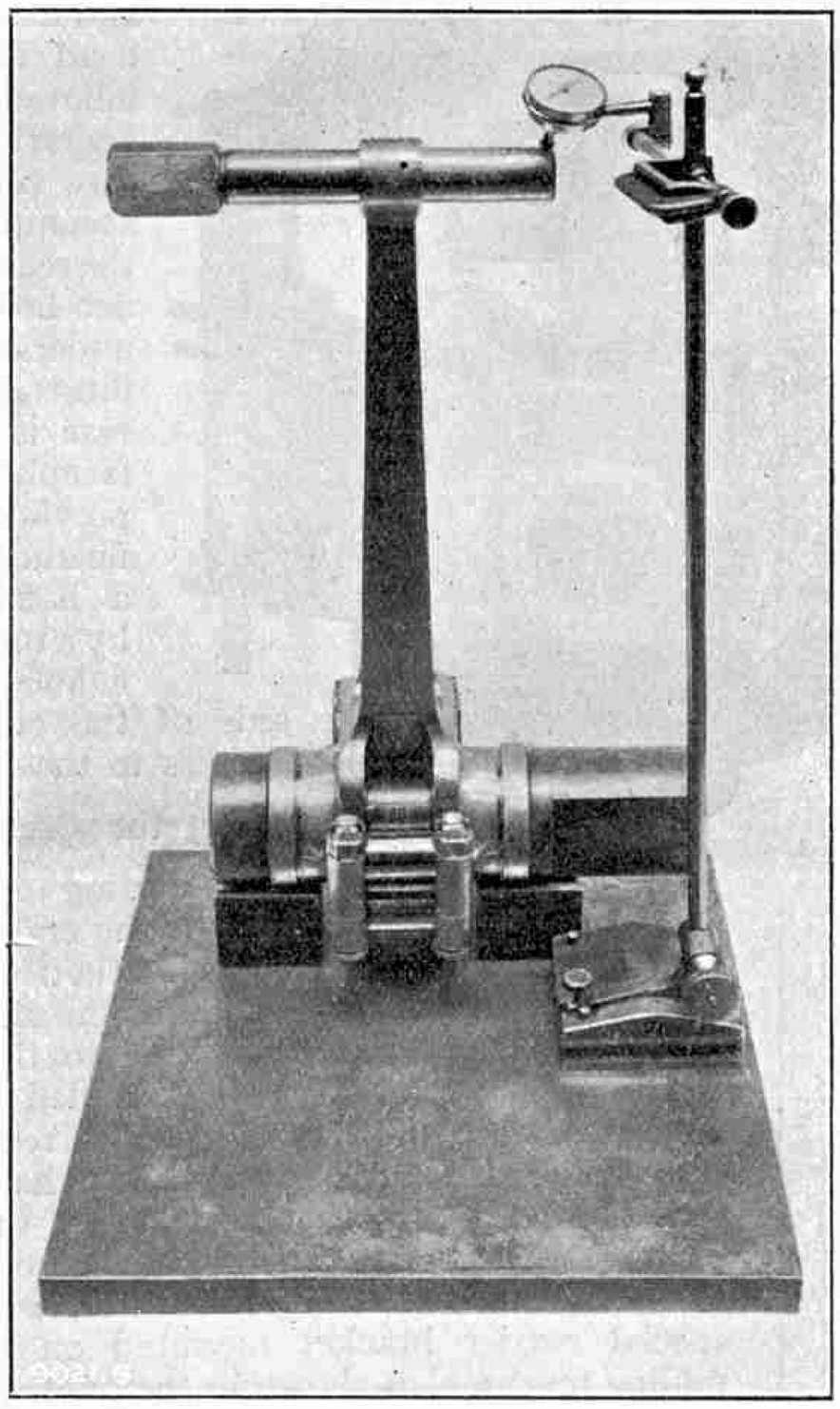


Fig. H. Method employed to Test the Alignment of the Master Rod

For reaming the bearing, the assembled rod is placed on a jig and located by an accurately-turned white-metal shell flange, a special taper bush being fitted over the locating spindle to prevent the rod from tilting. The clamping cap is tightened down by the two nuts shown and the locating bush is then withdrawn, leaving the rod located centrally in the jig ready for the reaming operation.

This is done by hand with an adjustable reamer to within 0.0005 in. of the true size, so that but little hand scraping is necessary in bedding the bearing on to the test mandrel. The latter, it should be mentioned, is ground 0.003 in. larger in diameter than the crankpin, and after the rod has been carefully bedded so that it can just be felt to grip the mandrel, a clearance is cut in each half of the bearing separately to a depth of from 0.0015 in. to 0.0025 in., by means of a special hand recessing tool. Two oilways, $\frac{3}{8}$ in. in width and 0.01 in. in depth, are subsequently cut in both halves of the bearing on the end faces, these being important, not only for the distribution of the oil but also, to some extent, for regulating the quantity of oil flowing through the bearing.

The operation of reaming the small-end bush is carried out by means of special adjustable piloting reamers.

The method of testing the alignment of a rod is illustrated in Fig. H. The rod is bolted on to the bedding mandrel, above referred to, and with the test bar in position in the small-end bush, the whole is mounted vertically on vee blocks on a faceplate as shown. A dial indicator clamped on to a scribing block is used for checking the alignment, an allowance of 0.0005 in. being made for every inch in length of the test bar. That is to say, with a test bar 6 in. in length, the difference in the readings taken at opposite ends of the bar must not exceed 0.003 in. A similar method is used for testing the twist of the rod which, for this purpose, is set up horizontally on the faceplate.

Testing the Engines

All material received at the works is delivered to the rough-material stores. Here it is checked and retained until chemical tests have been made and the material has been passed by viewers and Government inspectors.

All the components of the engine, excepting magnetos and a few carburettor details, are machined in the machine shops and passed to the finished stores before proceeding to the fitting shop, where the engine is sub-assembled and erected. The complete engines are then passed to the test house, where they are tested on the brake, under Government supervision. They are afterwards sent to the stripping shop, where they are dismantled and examined by other Government inspectors, and finally re-erected, put through a further test and despatched.

In the test house, an illustration of which is shown on page 215, are two complete Froude dynamometer units, each equipped with the necessary apparatus for measuring fuel and oil consumption, as well as the power developed. Cooling air is supplied while a test is in progress through the trunk shown in the illustration by means of a fan, driven by a 270 h.p. electric motor. A single-cylinder test-bed is also provided for experimental work.

In concluding our account of the Bristol "Jupiter" engine and its production, we need scarcely point out that there are many other machining and testing operations of interest and importance quite equal to those described here, that might well have been dealt with had space permitted. Those selected, however, are reasonably representative of several others, and they certainly serve as some indication of the efforts made by the manufacturers to secure interchangeability in conjunction with high-class workmanship and finish, upon which the reliability of any aero engine so largely depends.

We have to thank the Bristol Aeroplane Co. Ltd. for their courtesy in enabling us to publish these interesting details and feel sure that all our readers will have a keener interest than ever in "Bristol" engines, having read of the wonderful care exercised in their manufacture.

Feeding 3,680 Passengers for a Week—

(*Continued from next page*)

Queen Mother—a point that illustrates the way in which all stocks and equipment are kept up-to-date.

The regular meals on a great liner are supplemented by early cups of tea, the mid-morning bowl of soup, and, of course, afternoon tea—the amount of tea and sugar consumed is incredible. Small matters that add much to the comfort of the passengers, but the labour entailed in this way is enormous. The service is most efficient—it has to be, otherwise the work could never be done.

Fresh water tanks occupy a large amount of space in the modern liner. Boiler water is carried usually in the double skin of the ship, but bath and drinking water is contained in special tanks, that are used for no other purpose and are placed away from the skin of the ship, in order that there can be no danger of pollution by leakage from the outside.

On all liners the amount of fresh water taken aboard is computed by the ton. The "*Majestic's*" tanks hold no less than 4,750 tons, whilst a ship of the Celtic class (registering 21,000 tons) carries about 1,800 tons.

When such a ship as the "*Belgenland*" is on a cruise around the world, her tanks are refilled at each port of call. Fresh hot and cold water being provided at the basins in all staterooms of this ship, the consumption of water for washing necessarily is higher than where hot water is "laid on" only in a few first-class rooms.

While the water placed in the ship's fresh water tanks in most ports is pure enough to drink when taken aboard, precautions are taken to filter it three times before it is used for drinking purposes, and twice before it is allowed to run to the bathrooms. The filtration plant, in which the water runs through a series of mineral plates or porcelain tubes, is on the upper deck. From this point the water passes by gravity to all parts of the ship.

Careful estimates of the daily consumption of fresh water per first class passenger on these ships show that it is from 30 to 50 gallons, a fair average being 40 gallons. In other classes it is less, the average for third class passengers being about 15 gallons a day, as against three pints a day in 1866, the advertised allowance for this class of passenger! The general average is 25 gallons a day.

In the course of a year, some three and a half million pieces of linen pass through the White Star laundry at Southampton, which does the washing for the "*Majestic*," "*Olympic*" and "*Homeric.*" Attached to the laundry is a sewing-room fitted with electrically driven sewing and darning machines, where nearly two hundred thousand pieces are annually repaired.

Feeding 3,680 Passengers for a Week!

Wonders in Catering performed on the "*Majestic*"

TO provide meals for a week for 3,680 people would be no light undertaking ashore. The task becomes infinitely more difficult, however, when the meals have to be provided at sea—and the necessary provisions arranged for at the commencement of the voyage. Yet meals on the "*Majestic*" are provided with the regularity of a well managed modern hotel—which, indeed, is what the "*Majestic*" really is—a palatial floating hotel.

The "*Majestic*" carries 900 first, 680 second, and 1,000 third class passengers, in addition to a crew of 1,100. The meals for the first class passengers are served simultaneously, but there are two sittings in the second and third class. Even so, all meals are finished in an hour and a half, which, upon consideration, appears to be a record performance.

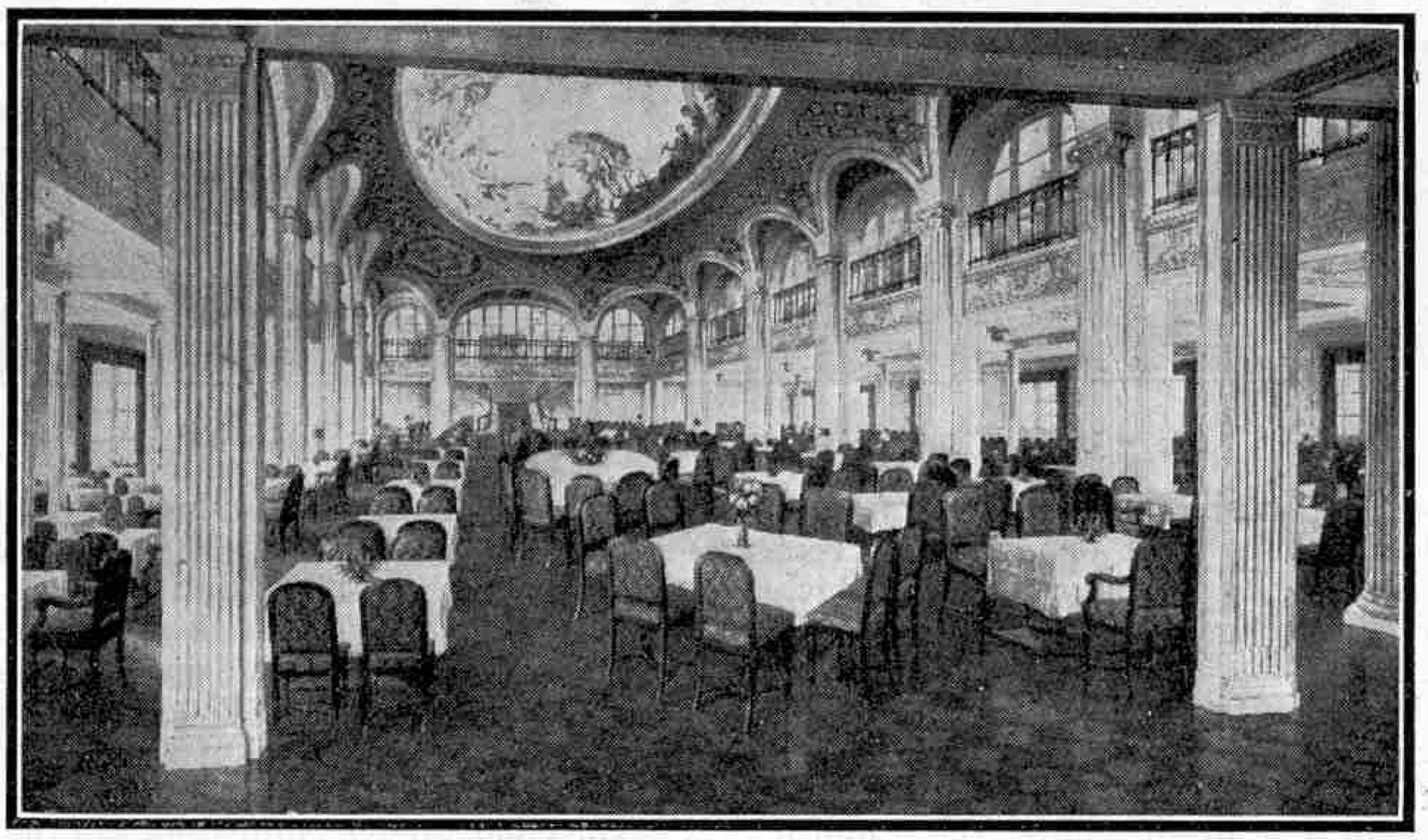
There are few hotels where every seat in the dining room is occupied on the stroke of the clock, and none where three grades of guests are served at once in separate saloons. Nor is there any hotel where every item of food has to be provided in advance, and stored for days without the possibility of renewal. To carry provisions sufficient for some 3,680 people for the duration of a voyage is a problem that would confound any but the victualling department of a great steamship company.

But Mr. Bartholomew, the Victualling Superintendent of the White Star Line, has been fifty years at the work, and has a great reputation on the seas. He has evolved a most efficient system based on experience, ensuring that nothing is lacking. He has provided a standard of catering that, even in the third class, is better than that enjoyed by the average householder. First and second class passengers experience all the luxury of the most exclusive cuisine.

Stocking the Ship before a Voyage

Every ship of the White Star Line is provided with a printed list of stores, containing some 900 items. This sheet is checked and worked out to three places of decimals, and is almost a guarantee that no item of food can be overlooked. The average daily consumption of beef, mutton, poultry, bacon, tea, sugar and everything else, is seen at a glance. At the completion of a voyage the Victualling Department know the results—even the number of mixed biscuits used in the first class for afternoon tea.

During a voyage menus are arranged by the Chief Steward, but when the liner comes into port again these are submitted to the Victualling Department to be checked. Although every precaution is taken to guard against waste and extravagance, there must be no stint, and any attempt to economise at the expense of the passengers is quite rightly most strongly condemned.



First Class Dining Saloon on the White Star Liner "*Majestic*"

The store rooms of a ship are like a series of shops, except that the temperature varies according to the nature of the commodity. Only English beef, mutton and lamb is supplied to the first-class passengers, and none of the meat is frozen, but chilled in the refrigerator.

There are 130 cooks, butchers and bakers on the "*Majestic,*" and most of them are kept busy all the time. Cooking is done by electricity, and the kitchens are beautifully clean and fitted with modern machinery.

Goods are bought in bulk by the Purchasing Department, and markets are watched very closely. Experience has proved that certain kinds of flour, for instance, keep best on sea board, and that some potatoes are more satisfactory than others for use on a ship. There are innumerable details of this kind brought to light by years of experience, and these are valuable points that not only help towards economical catering, but do much to increase the pleasures of the table for the passengers in all classes.

Incidentally it may be mentioned that a modern liner must carry everything that is to be found in a home, hospital or an hotel. Even gramophone records have to be brought up-to-date every voyage, and the stock of sundries includes such things as needles and coffins!

Every ship of the White Star Line carries a Catholic Altar, and a set of Communion vessels for use at the Church of England service.

A newspaper is published on board, and delivered at each passenger's door every morning. This paper contains the latest news received by wireless, and is a bright and entertaining publication. During last year the entire stock of prayer books carried by every ship of the fleet was overhauled, owing to the alteration required in the text caused by the death of the (*Continued on previous page, col. 3*)

The Conquest of the Air

XXIII. Two Famous French Aeroplanes—"Goliath" and "Jabiru"

The "Jabiru," fitted with two engines and thickened wings

FRANCE has taken a notable part in the conquest of the air and this is only what one would expect from a country claiming to be the one from which man rose in the air for the first time in an apparatus of his own construction.

The famous brothers Montgolfier were the pioneers of aeronautics in France. They were followed by Clement Ader, the "Father of Aviation," Farman, and later by Bleriot, the first airman to fly across the English Channel. The early accomplishments of these men are matters of history.

During the war, aviation in France showed considerable activity and progress and the construction of the large air-liners of to-day has certainly been made possible by the experience gained during the war. Great strides were then made in the construction and perfection of larger aircraft than had before been thought practicable.

After the war most countries realised the great value, both commercially and internationally, of an efficient and regular air service, for passengers and mails. France entered upon an energetic programme and there are now five companies running regular air services. During the year 1924 these companies carried 16,729 passengers, 864 tons of goods and 524 tons of mails. In making 11,536 flights their machines covered 2,266,759 miles, representing roughly 33,000 hours actual flying time.

Most of this traffic passed through the aerial port of Le Bourget, which dealt with no less than 14,715 passengers and 956 tons of goods during the year 1924, as against 11,065 passengers and 657 tons of goods in the previous year, from which figures it will be seen the aerial traffic to and from this part is fast increasing.

The chief French companies are the Air Union—which works the Paris-London route; the Société Général des Transports Aeriens, flying between Paris and Amsterdam; the Franco-Roumaine, which links up Paris and Constantinople; the Cie d'Enterprises Générales Aéronautiques, connecting Toulouse, Casablanca, Oran and Alicante; and finally the Cie Aéro-Navale, which runs a service between Antibes and Ajaccio.

Beside these five French companies two other air lines also serve France, the Imperial Air-man (Paris-London and Paris-Zurich) and the K.L.M. (Paris-Amsterdam), so that France is by no means badly off in the matter of commercial air services.

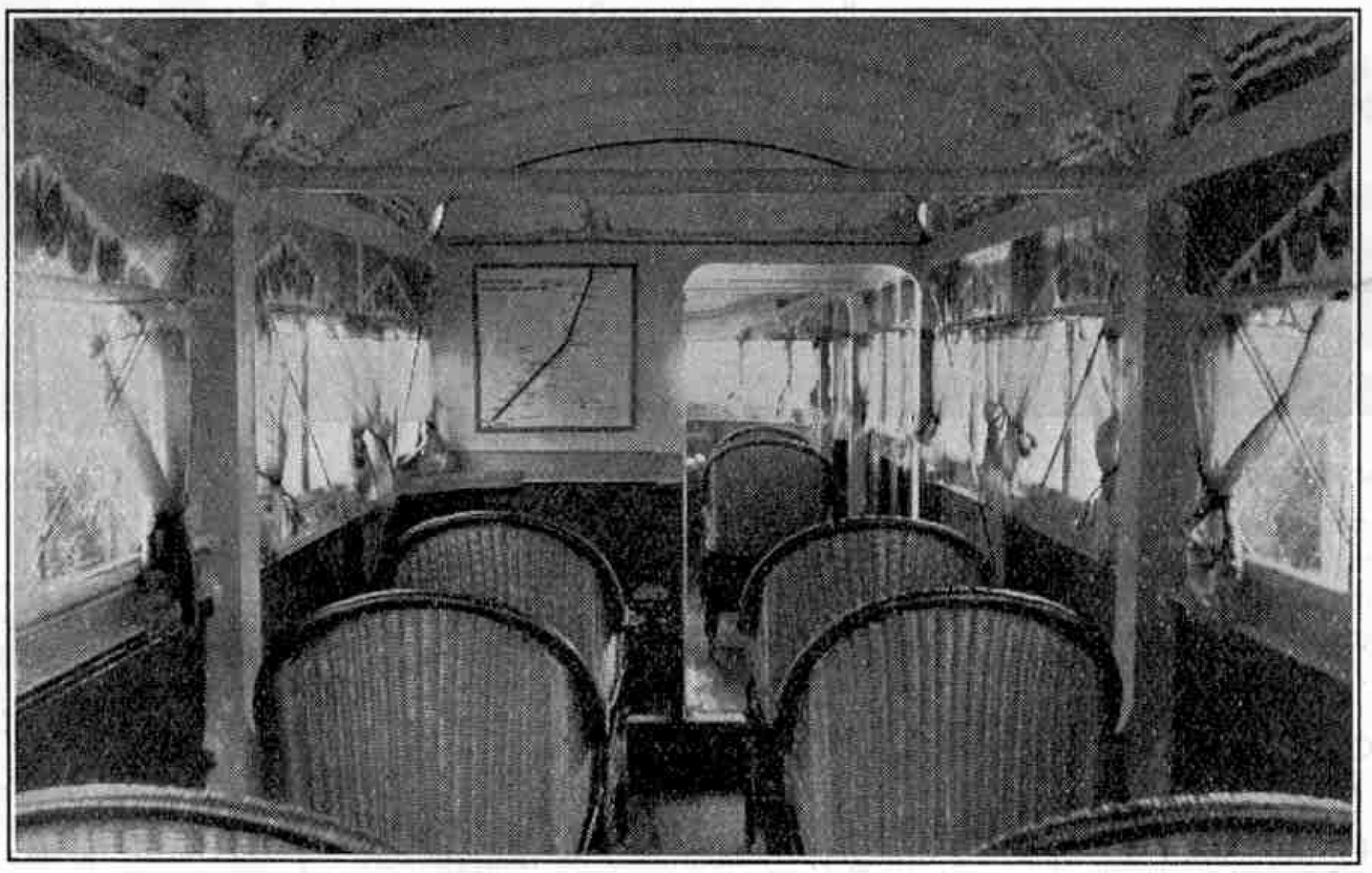
Although experiments with giant aeroplanes were carried out before the war, the construction and use of the large passenger-carrying machines has been adopted

Previous articles in the "Conquest of the Air" series have appeared as under :—

1.	The Lympne Trial for Light Monoplanes	Mar. 1925	11.	Boulton "Bugle" ... ... Feb. 1926
2.	Beardmore "Wee Bee I."	Apl. „	12.	The Flight from London to the Cape ... Mar. „
3.	Super-Seaplanes for U.S. Navy	May „	13.	Light Aeroplane Clubs ... ... Apl. „
4.	Argentine Airman's Attempt to Circle the Earth	June „	14.	D.H. 54 (de Havilland) "Highclere" ... May „
5.	Parnall "Pixie III."	July „	15.	Vickers (Rolls-Royce) "Vanguard" ... June „
6.	De Havilland "Moth"	Aug. „	16.	De Havilland "Hercules" ... ... Aug. „
7.	Beardmore-Rohrbach All-Metal Flying Boat	Oct. „	17.	Handley Page "Hampstead" ... ... Sept. „
8.	Fokker C.V. Scout	Nov. „	18.	Gloster "Gamecock" ... ... Oct. „
9.	Vickers "Vimy" Ambulance	Dec. „	19.	Parnall "Plover" ... ... Nov. „
10.	The Cierva Auto-Giro Flying Machine ...	Jan. 1926	20.	Sir Alan Cobham's Flight to Australia Dec. „
			21.	"Southampton" Supermarine Flying Boat Jan. 1927
			22.	Cairo—Karachi Air Route ... ... Feb. „

generally to meet the requirements of an efficient and regular passenger service between one country and another.

Many of these large aeroplanes have been constructed by the famous French firm of Farman, who have some splendid records standing to their credit. Among these machines is a two-engined biplane "Goliath," which broke the world's endurance record in 1922 by a flight of 34 hours, when it covered a distance of 2,485 miles. In 1925 the same machine broke the height record of 20,676 ft. with four passengers on board, and 16,728 ft. with 25 passengers. There is accommodation in the cabin of the "Goliath" for 12 passengers, and from the cabin, which is particularly comfortable, travellers have an uninterrupted view through the large windows running along each side. Our photograph gives an excellent idea of the comfort and size of the saloon of the "Goliath" machines.



Passenger saloon of French "Goliath"

In addition to accommodation for the 12 passengers, pilot and mechanic, the "Goliath" is also able to carry merchandise and mails. The weight of the aeroplane is 2½ tons and it has a capacity for carrying an equal weight. The spread of the wings of the "Goliath" is 87 ft. and the area 519 sq. ft.

It was an aeroplane of the "Goliath" type that in 1919, on the Paris-Koufra-Senegal flight, flew from Paris to Casablanca without a stop. This performance broke the French record for distance and gained the world's record for a flight of 2,485 miles in 36 hours—a truly remarkable achievement for an aeroplane of that period.

The Farman firm have latterly built a type of monoplane with thickened wings, so making possible the fitting of a stronger framework. This type, which is equipped with two, three or four motors according to requirements, is named "Jabiru" and has a wingspread of 62 ft., a length of 45 ft., and a total wing surface of 296 ft. In addition to seats for pilot and mechanic and accommodation for luggage, there is a passenger saloon capable of accommodating twelve persons. The machine develops a speed of 124 miles per hour and has attained a maximum height of 13,950 ft. carrying a full load of 5 tons, of which 3¼ tons constitute the weight of the machine itself. All the latest improvements are embodied, including a full equipment, with wireless, flares and lighting apparatus, for night flying. Hispano engines are fitted but Lorraine engines are substituted if and when desired.

The "Jabiru" class has proved particularly airworthy. Piloted by the French airman Landry, one of these machines flew from Paris to Prague, a distance of 550 miles with only one stop on the outward journey—the return journey was accomplished without a stop—at an average speed of over 124 miles per hour.

In our illustration on the previous page, is shown one of the "Jabiru" machines fitted with two engines. The thickened wings are clearly shown.

Two other French machines that came specially into prominence during the summer of 1926, in connection with the French propagandist long-distance non-stop flights, were the Potez and Breguet biplanes.

Probably the latter is the better known of the two machines for it was a Breguet XIX., of the "Grand Raid" type, that played so prominent a part in the Paris-Teheran flight in November, 1925. During the course of this flight, which lasted 2½ months, the machines, three Breguets and one Potez, gave demonstration flights in Italy, Serbia and Roumania and eventually reached Persia. During one flight, the "Grand Raid" Breguet flew over Mount Denavend, 18,600 ft., carrying the Persian War Minister as passenger. The machines returned to Villacoublay towards the end of January last year, after covering approximately 7,800 miles in 104 flying hours, and experiencing all sorts and conditions of weather.

The Potez biplane used in this flight was of the type known as 25, and was equipped with a 420 h.p. Bristol Jupiter engine. The machine's tanks were designed to carry approximately 570 gallons of fuel and its total weight, including petrol and oil was 7,500 lbs. A similar machine, fitted with a Renault 550 h.p. engine, was used in the record-breaking non-stop flight from Paris to Bassorah (2,735 miles) made by the brothers Arrachart in June, 1926. This particular 'plane was of wood and metal construction and had a wing span of 55 ft. 7 in., the total area of the planes being 667 sq. ft. The height of the machine was 14 ft., and it weighed when fully loaded 10,690 lbs. A Potez 25 was used in the attempted flight from Paris to Tokyo, via Russia, but the project had to be abandoned owing to an accident when the machine, piloted by Capt. Pelletier Doisy, had reached Warsaw.

As we have stated previously, the Breguet XIX. came into particular prominence during the attacks on the world's non-stop flight record, organised last summer by the French Government, and in July Captain Girier and Lieutenant Dordilly succeeded in flying from Le Bourget to Omsk, Siberia, a distance of 2,940 miles in 29 hours. In addition to setting up a new world's record, this flight secured the award of the Renault Cup for 1925/26 which carried with it a cash award of 50,000 francs (nominally £2,000) and an objet d' art valued at 5,000 francs (£200).

This machine was fitted with a 450 h.p. Hispano-Suiza motor and its full weight, including fuel, passengers, etc., was approximately 8,580 lbs.

Trams v. Motor Buses

In view of the keen controversy regarding the respective merits of trams and motor buses, the opinion of Mr. J. B. Priestley, General Manager of the Liverpool Corporation Tramways, is of considerable interest.

In a report to the Corporation, Mr. Priestley stated that in his view it was impossible for omnibuses to compete with tramways if journeys of more than 15 minutes' duration were to be undertaken. Apart from the capital outlay caused by any change from tramways to buses, the amount paid by the tramways to the city in the form of rates and road maintenance would not be paid by the buses. In addition, the buses, by purchasing petrol instead of electric current, removed a certain proportion of profit from the city.

Mr. Priestley added that a point apart from financial considerations was that of safety and reliability. The braking power of tramcars was recognised to be greater than that of other vehicles and tram-cars could be run in foggy weather when no other service could be maintained.

* * * *

Irrigation of the Deccan

Two huge schemes for the irrigation of the Deccan have been completed by the Bombay Public Works Department, namely, the Nira Canals extension scheme and the Pravara Canals scheme. In the course of the former work the Lloyd Dam at Batghar was built. This huge structure is 190 ft. in height, 5,333 ft. in length and it impounds twenty-four thousand million cubic feet of water in a lake 15,000 square miles in area. This dam is claimed to be the largest in the world and the amount of masonry in it exceeds by 3,000,000 cu. ft. that contained in the Assuan Dam. The total area to be commanded by the Nira Right Bank and Nira Left Bank Canals is 900,000 acres.

The other scheme comprises the Pravara Right and Left Bank Canals with a storage lake at Bhandardara. The Bhandardara Dam is 270 ft. in height and 1,600 ft. in length, holding thirteen thousand million cubic feet of water and commanding an area of 183,000 acres.

During the past eleven years the total area in the Deccan to be irrigated has increased from 100,000 acres to 240,000 acres.

Sand-Dredging in the Great Lakes

Dredging for sand for use in filling "made" land, and for building materials, asphalt paving and other purposes, is an important industry on the Great Lakes of America. One of the hopper dredgers used for this purpose in the neighbourhood of Chicago is a converted ocean steamer, 265 ft. in length, 43½ ft. in beam, 20 ft. in draught when loaded and fitted with triple-expansion engines placed amidships. This dredger, by means of its main centrifugal pumps, is able to take up a cargo of 2,200 cu. yds. of sand in 1½ hours and to discharge this sand ashore from the hoppers through 1,500 ft. of pipe in two hours, pumping it to an elevation of 35 ft. The vessel carries a crew of 27 men and has a loaded speed of 14 knots.

* * * *

A Substitute for Petrol

The serious attention given in France to the manufacture of substitute motor spirit is well illustrated by recent developments. A report of the results of trials carried out with a "white spirit," a non-inflammable liquid at normal temperatures, was read recently by M. Dumanoir in Paris, before a meeting of the Academy of Science. He stated that, using the "white spirit" as engine fuel during a trial aeroplane flight lasting about 30 minutes, he observed that at 9,000 ft. ample power was apparent and that slow engine speeds could be obtained without misfiring. He considered that, from the point of view of maximum engine revolutions, the new spirit was inferior to petrol at ground level but superior to it at 9,000 ft.

It is claimed that this substitute for petrol is non-inflammable at 85°F. and that it is possible to apply a lighted match to it without causing it to ignite.

A factory for the production of artificial motor spirit is being constructed at Lens. The materials necessary are all obtained from the destructive distillation of coal which, of course, is abundantly available in the district. If the experiments now being undertaken prove successful it is proposed to build a larger factory capable of turning out several tons of the substitute every day.

* * * *

A new railway bridge over the Myitnge river, about nine miles south of Mandalay, has recently been completed. It consists of four spans of 150 ft. and two of 40 ft., and has been built in just under two years at a cost of about £60,000.

Steel Welded to Copper

The importance of definite and permanent contact between the steel rails of electric transport systems makes obvious the utility of efficient steel and copper welding processes. One method of obtaining the necessary electrical connection has been to prepare lengths of annealed copper cable having a steel terminal welded to each end, these terminals subsequently being welded to the rails as required. Recently further discoveries have resulted in a method by which copper may be joined direct to the steel under the conditions found during rail-laying. The principle is that of maintaining molten copper in contact with the steel, excluding oxygen, until the steel has been heated to the melting point of copper. In practical application to track-laying a mould is set against each position where the rails are to be connected. By means of an electric arc a special alloy of copper is melted into the mould, uniting with the strands of the connecting cable and after about 35 seconds forming an effective weld. Unless a heavy layer of rust covers the surface of the steel it is found that the copper alloy will remove any oxide or scale from the rail.

* * * *

New Cross-Channel Steamers

The L.M.S. have placed an order with Messrs. William Denny Bros., Dumbarton, for three new twin-screw geared turbine steamers to be used on the Holyhead-Dublin service. The contracted speed for the new ships is 21 knots.

* * * *

Congo Barrages

It is proposed to construct seven barrages in the Congo to change the river cataracts above Matadi into waters navigable by large ocean steamers, and to utilising the power thus obtained to produce electricity on a large scale.

While the expenditure necessary for the realisation of such an ambitious project will be large, it is stated by the H.M. Consul at Boma that this would be justified by the probability that the alternative, a reconstructed railway, would again fail, and some means of communication is essential if the potential wealth of the Belgian Congo is to be developed.

* * * *

The two bearings of the Sydney Harbour Bridge were carried from Darlington to Middlesbrough during January; the weight of each is 300 tons.

New Nile Bridge Completed

Towards the end of 1925 a contract was given by the Administration of the Egyptian State Railways to Dorman, Long & Co. Ltd., of Middlesbrough, for the construction of a new steel railway bridge to cross the River Nile at Dessouk, Lower Egypt. The old bridge had become utterly unsuitable for carrying a modern railway and indeed only a locomotive and a single vehicle were allowed to cross at one time. The contract price was £142,560 and this included the demolition of the old bridge and the construction of the new one within twelve months. This has been successfully accomplished.

The bridge has been built to span the Nile, connecting Dessouk and Rahmanieh on opposite banks, by way of the island in the centre of the river. Four spans of 200 ft. 8 in. join Rahmanieh and the island, while four similar spans, an electrically operated swing span and a shore span of 177 ft. 6 in. connect the island with Dessouk. The swing span is, of course, to allow river traffic to pass beneath the bridge.

The piers of the old bridge have been re-capped and strengthened to act as the foundations of the new bridge. This is designed to take a single railway track between the main girders, with a roadway 11 ft. in width for wheels and foot traffic, carried by cantilever brackets on each side of the bridge. Some 3,800 tons of steelwork have been used in the construction and the total length of the bridge is 2,000 ft. or about twice the length of Waterloo Bridge.

* * * *

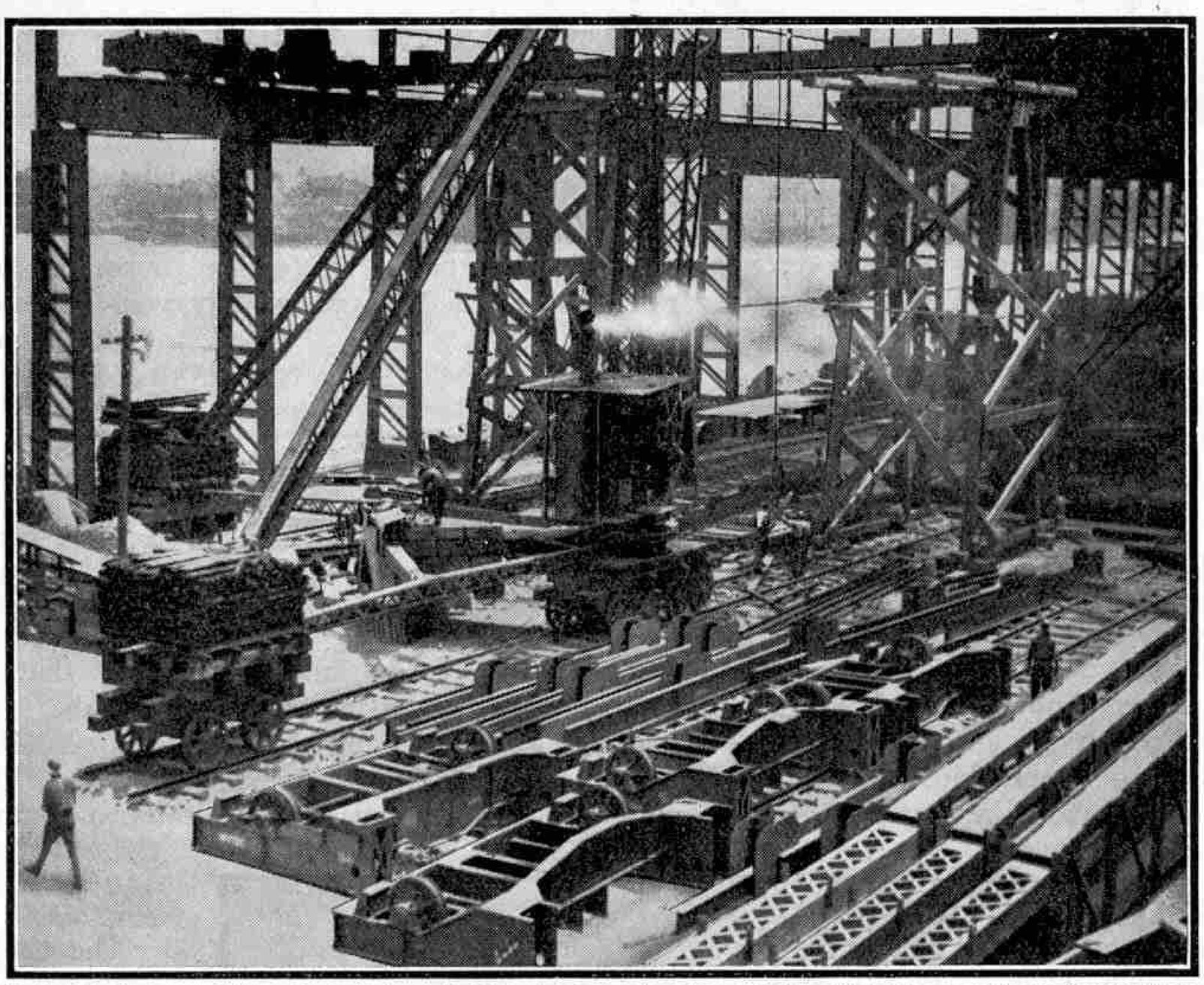
Moving a Bridge

Californian engineers recently succeeded in moving into place a new 6,000-ton bridge to replace an old structure. This feat was accomplished at Montebello, just outside Los Angeles, on an important inter-city highway. The old bridge was prepared for demolition and the new, already completed, was pushed into place with powerful jacks. It is said that motorists drove across the bridge as it slid on the steel rails.

Stainless Steel Road Studs

The latest use that has been found for stainless steel is the manufacture of road studs for the direction of traffic. These studs have been used for this purpose in the main streets by the Sheffield Corporation. Between one and two thousand studs, made of "Staybrite" steel, have been supplied by the Firth Derinon Company, of Tinsley, and so far have been found to be very satisfactory.

Building the Sydney Harbour Bridge



Part of the huge workshops, the largest ever built for bridge construction, at Sydney Harbour, where the work of building the world's largest arch bridge is proceeding apace. Our readers will remember that this bridge was the subject of a special article in our December and January issues

Protecting the Eiffel Tower

The problem of providing adequate protection for the steel work of the Eiffel Tower is engaging the serious attention of experts.

The tower was built in 1887-89 and was first protected by the application of three coats of a special mixture of red lead and linseed oil with a final thick layer of paint. Within two years this protective covering was destroyed and rust was eating its way into the steel. A mixture of white lead, linseed and ochre was then used, but the tower has had to be re-painted four times since then, a variety of protective paints being used. The last painting was carried out in 1924, but corrosion has not yet ceased and it is felt that ultimately the tower is doomed unless some thoroughly efficient coating can be found.

The magnitude of the task of painting the Eiffel Tower will be realised when we state that in 1924 thirty tons of paint were used and the work occupied 100 men for a total period of 4,000 hours.

Table Bay Harbour

The work on Table Bay Harbour, South Africa, has made rapid progress and about 200 concrete blocks weighing from 15 tons to over 30 tons have been placed in position as part of the 1,500 ft. extension of the breakwater. A large amount of land is to be reclaimed from the sea and this work also is well advanced.

The object with which this task has been undertaken is that of making possible the widening of the south arm of the breakwater. So far, 1,657 lineal ft. of the quay wall has been built up to the required level, mass concrete has been laid for a distance of 1,315 ft. and 1,126 ft. of coping has been set in position. A breakwater to the east of the present docks is under construction and 300 ft. has already been built. This breakwater will be constructed to form a curve approaching the extension of the south arm of the docks, the opening between it and the pier forming an entrance to the new docks under construction to the east of the present docks.

Three Goliath cranes and a pile-driver are being used in the work of extending the new south pier, while another crane is lowering concrete blocks weighing some six or seven tons into the sea to act as a foundation. Trucks carrying undressed stone or rubble are run alongside the crane track and the rubble is dumped as required by the positions of the concrete blocks. The new floating dock to dock small craft of from 400 to 500 tons has been assembled and launched and already has been used by some of the steam trawlers.

* * * *

New British Submarines

It is stated that a contract for three new submarines each costing over £500,000 has been given to Vickers Limited by the Admiralty. It is anticipated that, as soon as the necessary steel is available, the firm will be able to employ 1,500 more men in the shipbuilding and engineering departments of their Barrow works for a period of two years.

LIVES OF FAMOUS INVENTORS

I. WATT AND THE STEAM ENGINE

This month we commence a series of articles on the Lives of Famous Inventors, on somewhat similar lines to our existing series dealing with Famous Engineers. Almost all great engineers have been inventors to some extent while many inventors have been also engineers, and in many cases it is difficult to decide in which category to place certain men. In the present series, commencing with James Watt, the Father of the Steam Engine, we shall include men whose inventions rather than their engineering work have contributed towards the world's progress.

JAMES WATT was born on 19th January, 1736, in the Scottish port of Greenock, where his father carried on a large business as a carpenter and shipwright. The products of the busy workshop varied from furniture for ships to capstans for quays. In addition, the work of a builder and contractor was dealt with, and it was Watt's father who erected the first crane on a Greenock dockside, this being put up for the use of the tobacco-trading vessels that came over from Virginia. The Town Hall and Council Chambers built at Greenock in the 18th century were also his design and work. Watt's father was also part owner of several ships trading with foreign countries. In this matter he suffered serious misfortunes in later years, sustaining a heavy financial loss when one of these vessels was wrecked. Still worse was the loss of one of his sons while on a voyage to America in another of these ships.

Of the five children in the family, only James, the future inventor, lived to a good age, and for many years the possibility of his enjoying a long life appeared to be remote. During the early years of boyhood he was extremely delicate, and was practically an invalid, and it was not until he was fourteen years of age that he was considered strong enough to attend school. His early education was received in the home, his mother teaching him to read and his father imparting to him some arithmetic, in addition to the ability to write.

Watt's house in Delftfield Lane, Glasgow

Early Constructive Ability

When not busy with these studies Watt devoted many quiet hours to dissecting his toys and either rebuilding them or evolving new creations from the miscellany of loose parts. A further source of delight to him was provided by a set of carpenter's tools brought by his father from the workshop, and in the use of these the boy became very skilful. Later, in the intervals of schooling, he would resort to his father's workshop and continue his hobby. His ingenuity in making small articles was very marked and often evoked from the workmen the remark that "little Jamie had gotten a fortune at his finger ends." A bench was fitted up for him and also a small forge. He was thus able to extend his activities to metal work and his bench soon became arrayed with model cranes, pumps, capstans and the like, to the great delight and interest of his father's employees.

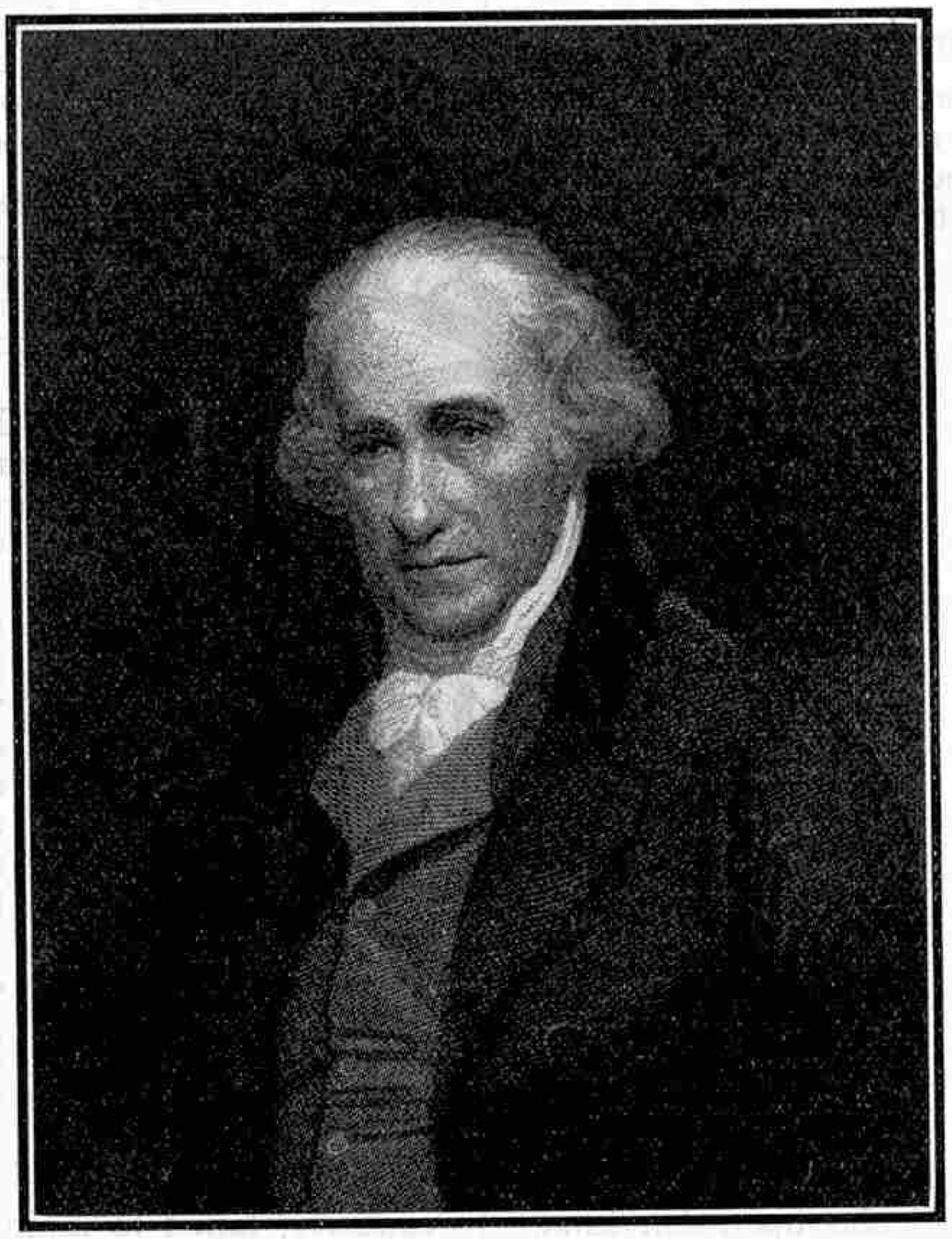
The delicate operations of adjusting and repairing nautical instruments fascinated him most of all, and when eventually he was permitted to experiment he quickly became remarkably skilful and accurate. His proficiency in this respect, his love of tools and the good grasp of mathematics he acquired at school paved the way for his training as a mathematical instrument maker, to which trade his father decided to apprentice him.

In 1754, therefore, we find Watt, then eighteen years of age, arriving in Glasgow with but little luggage apart from his beloved tools. The city proved to be without a skilled mathematical instrument maker and Watt was placed under the tuition of a mechanic who, although trading as an optician, was a veritable "Jack-of-all-trades," his business including the repairing of fiddles and the

making and mending of fishing rods and tackle!

Apprenticeship in London

At Glasgow Watt became acquainted with Professor Dick of the University, who urged him to go to London and obtain more expert tuition. To Watt's joy his father readily agreed, and arrangements were made for Watt to accompany a relative named Marr, a sea-captain, who was about to journey south to rejoin his ship lying in the Thames. Accordingly on 7th June, 1755, the two set out for London on horseback, no stage coach as yet being run between Glasgow and the Metropolis. Travelling by way of Newcastle and the Great North Road, they reached London twelve days later.



James Watt

In London a year's apprenticeship was entered into with John Morgan, a reputable maker of mathematical instruments in Cornhill, for a premium of twenty guineas and the unpaid services of his apprentice. Watt quickly showed his determination to succeed. In spite of the long hours—five nights a week he worked until nine o'clock—he sought to make pocket money by executing small jobs on his own account. These were done after hours at his lodgings and sometimes necessitated his working far into the night. When he had time for outdoor leisure he seldom ventured out lest he should be kidnapped by one of the gangs of ruffians at that time in London making life a terror to the male population. Many of these gangs were employed by shipping companies to capture able-bodied men, who were hustled on board ship and later sold to owners of plantations in the colonies of North America!

The strain of the long working hours and the enforced confinement told heavily upon Watt and during the following year he decided to return to Scotland. With money sent by his father he bought many of the tools he would need to commence in business for himself, and materials wherewith to make the rest, and thus stocked he returned north.

Instrument Maker to Glasgow University

In Glasgow Watt found himself debarred by the Guild of Hammermen from commencing a business of his own or even erecting a small workshop, on account of his not having served within the borough the customary seven years of apprenticeship. The Guild had no power within the precincts of the University, however, and it was there that Watt found his opportunity. He had already repaired several scientific instruments for the University in a manner that greatly pleased the professors, and when the latter heard of the Guild's opposition they offered Watt two rooms within the college buildings, the one for a workroom and the other for use as a shop. The offer was gladly accepted and Watt was officially appointed resident "mathematical instrument maker to the University."

In a short time Watt became very popular among professors and students alike and his workroom was frequently the scene of earnest discussions on scientific matters. The discoverer of the principle of latent heat, Dr. Joseph Black, was then lecturer on chemistry at the University and he and Watt became great friends. John Robison, who is remembered as the designer and first editor of the "Encyclopædia Brittanica" was another close friend. It was in Watt's workroom that Black and Robison—who was at that time a student at the University—first met, and a life-long friendship began between them.

The three friends often met together in the young mechanic's room to discuss scientific matters. One day, in 1759, the conversation turned upon the subject of the steam engine and the possibilities of improving upon Newcomen's engine, at that time largely in use for pumping water out of mines.

Newcomen's Engine

The Newcomen engine was invented in 1705 by Thomas Newcomen, a blacksmith and ironmonger, of Dartmouth, and was based partly upon an earlier invention by Thomas Savery, which was brought out in 1698. Savery's pumping engine, as it was called, was very imperfect, but it provided a starting point for various inventors interested in the possibilities of the steam engine. Of these, Newcomen appears to have been the most progressive. It is related that, having by some means become acquainted with Savery's engine, he built a model of it in his garden and in studying its operation quickly perceived its many faults. After long experiment and many failures Newcomen finally evolved his atmospheric pumping engine.

In this engine a pipe fitted with a stopcock led up from the top of the boiler to a vertical cylinder containing a close-fitting piston. The piston rod was connected by a chain to one end of a beam overhead, which functioned see-saw fashion upon a central axis. From the other end of the beam hung a long weight, the bottom of which was attached to a pump rod. Steam was generated in the boiler and passed upwards into the cylinder at a pressure slightly greater than that of the atmosphere, thereby raising the piston. As the piston end of the beam was thus lifted, the other end was correspondingly lowered and the pump rod depressed. This motion was aided and steadied by the balance weight.

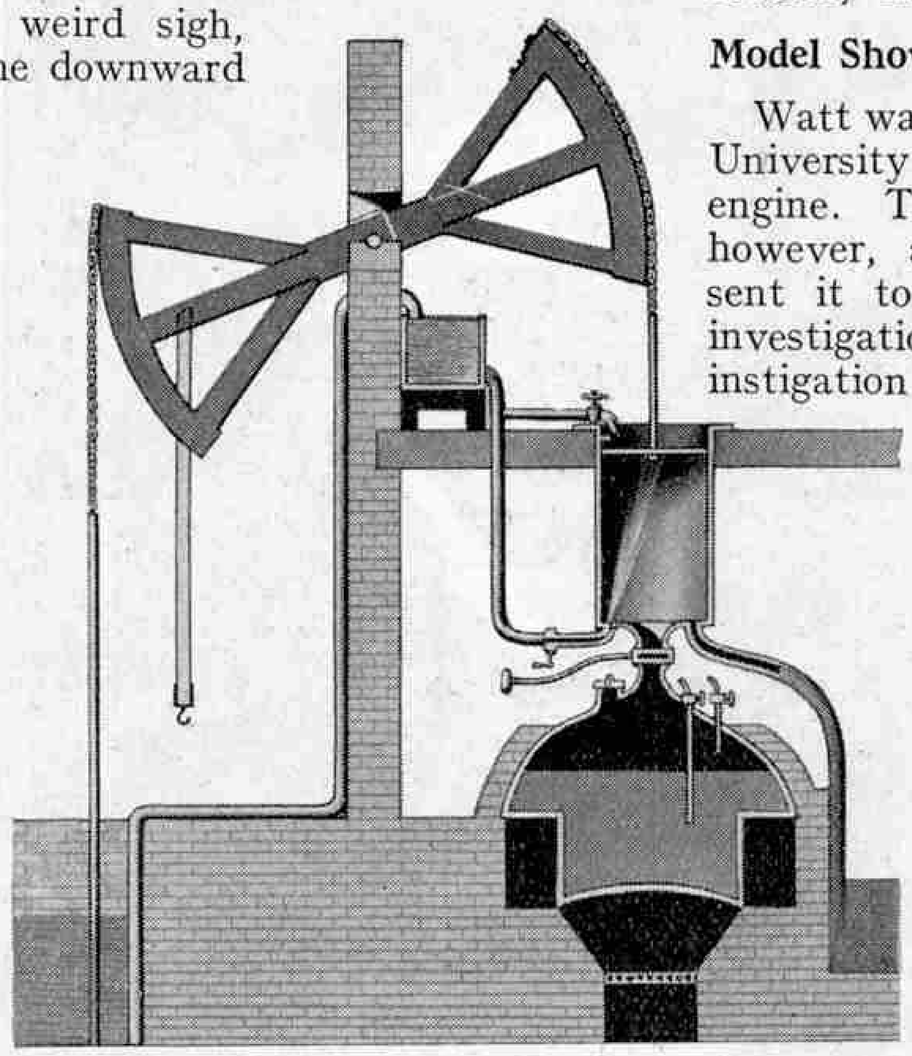
The stopcock was then turned to shut off steam. Cold water was passed down a narrow pipe from a cistern above the cylinder, entering the latter at the bottom in the form of a jet, and this, condensing the

steam, created a vacuum. The cylinder was open at the top and atmospheric pressure upon the piston immediately forced the latter down, thereby re-canting the beam to its original position and raising the pump-rod. The descending piston forced out the injected water and condensed steam through an escape valve into a pipe leading down to an adjoining well. Steam was then re-admitted to the cylinder and the cycle of operations repeated.

Noisy and Inefficient in Operation

The engine was extremely noisy in operation. As the pump rod descended, the sound of the plunge was accompanied by a weird sigh, and a loud bump denoted that the downward stroke was completed. With a squeak and a further bump the upward stroke was then commenced, the pump rod's chronic wheeze being rendered less audible by the sound of the rushing water as it was sucked up and ejected.

At first a man and a boy were required to work a Newcomen engine, the former attending to the fire and maintenance of steam while the latter looked after the stopcock for admitting steam into the cylinder and the injection cock for admitting cold water to effect the condensation. These two cocks had to be turned on and off alternately, a task which quickly grew very monotonous.



Newcomen's Atmospheric Engine

Invention due to Boredom !

The manner in which this particular operation came to be rendered automatic is very interesting. A boy named Humphrey Potter, employed as just described, was particularly struck by the dullness of his task. He noticed how the beam ascended and descended in slow succession and he sought for some way of keeping it moving while he had a rest. At length he contrived a catch that worked by strings tied to the beam, and found to his delight that his rough device was successful. Indeed, it had the effect of not only making the engine self-acting but of increasing the number of strokes from about six to fifteen per minute !

At a later date his innovation was improved upon by a man named Beighton, who affixed to the beam a rod, the lower or "free" end of which opened and shut the tappets of the two cocks as required.

Newcomen's invention failed to improve upon Savery's in regard to lessening the consumption of fuel. The drawback was not felt where the steam engine was installed at a coal mine, but where fuel was scarce, as at the tin mines in Cornwall the huge appetite of Newcomen's engines absorbed practically all the profits ! This excessive consumption of fuel was due to the wastage of steam caused by the alternate heating and cooling of the cylinder.

Watt's Interest Aroused

To Watt, who had never seen even a model of a steam engine, the discussion in his room on the subject opened up entirely new ground. Robison appears to have promoted this particular discourse. He suggested that the power of steam might be used for driving carriages by adapting Newcomen's principle, and that in order to avoid having a working beam the cylinder could perhaps be satisfactorily placed with its open end downward.

The subject greatly interested Watt and in leisure moments he gave it much thought. He experimented upon Robison's idea and made a rough model comprising two tinplate cylinders from which he purposed that the respective pistons and connecting rods should operate alternately on two pinions fitted to the axles of the vehicle. The model failed to work to his satisfaction, however.

Model Shows Defects in Newcomen's Engine

Watt was surprised to learn one day that the University owned a model of Newcomen's engine. The model had not worked properly, however, and the perplexed professors had sent it to a London instrument maker for investigation and adjustment. At Watt's instigation the model was sent for to be turned over to him to deal with. While he waited for its return from London he studied diligently the little that had been written of the experiments of others regarding steam. It is easy to picture his delight when at length the model arrived, and the eagerness with which he tried it out.

In due course Watt got the engine to work and was awarded £5 by the professors for his success. The limitations of the invention were apparent, however. The boiler, for instance, though seemingly of sufficient capacity, failed to maintain a steady supply of steam, with the result that after about a dozen motions of the piston the engine stopped for want of breath ! Such imperfections served only to increase Watt's resolve to invent an engine in which they would be successfully overcome.

Meanwhile his instrument-making business was not neglected. By 1760 it had developed so successfully that he decided to enlist more capital, and the same year he took into partnership John Craig, in co-operation with whom he transferred the business to larger and more suitable premises in the city. In 1764 Watt married a cousin named Margaret Miller and removed from his rooms at the college to a house in Deltfield Lane, a narrow thoroughfare since absorbed in modern street improvements. His business had prospered so considerably by then that he was able to provide regular employment for sixteen workpeople.

First Attempt Fails

During these years the subject of the steam engine remained uppermost in his mind, and every opportunity that offered itself was used to carry out investigations bearing upon the problem. Early in his experiments Watt devised a boiler that registered the amount of steam taken at every stroke of the engine, and the quantity of water evaporated during any set period. He discovered that the cold water injected into the cylinder to condense the steam already there was appreciably warmed by the latter, and that the steam was

capable of heating as much as six times its own weight of cold water to its own temperature. Considerably puzzled, Watt mentioned his discovery to Black, who outlined to him his theory of latent heat.

It was clear to Watt that a tremendous wastage of steam was taking place in the Newcomen engine, and he became more than ever determined to find some means of preventing it. He sought to reduce the wastage of steam by enclosing the boiler in wood instead of brickwork, and the cylinder and pipes in materials of similar low conductivity. In addition, flues were made through the boiler to increase its heating surface.

The improvement brought about by these measures proved negligible, however, and forced the resourceful inventor to the conclusion that somehow he must manage to keep the heat of the cylinder constantly equal to that of the admitted steam if wastage of the latter was to be entirely eliminated. On the other hand, he found that unless the steam in the cylinder was cooled down to at least 100°F. it did not fully condense, and the descent of the piston was proportionately retarded. How to satisfy these two opposite conditions was the problem upon which he now concentrated.

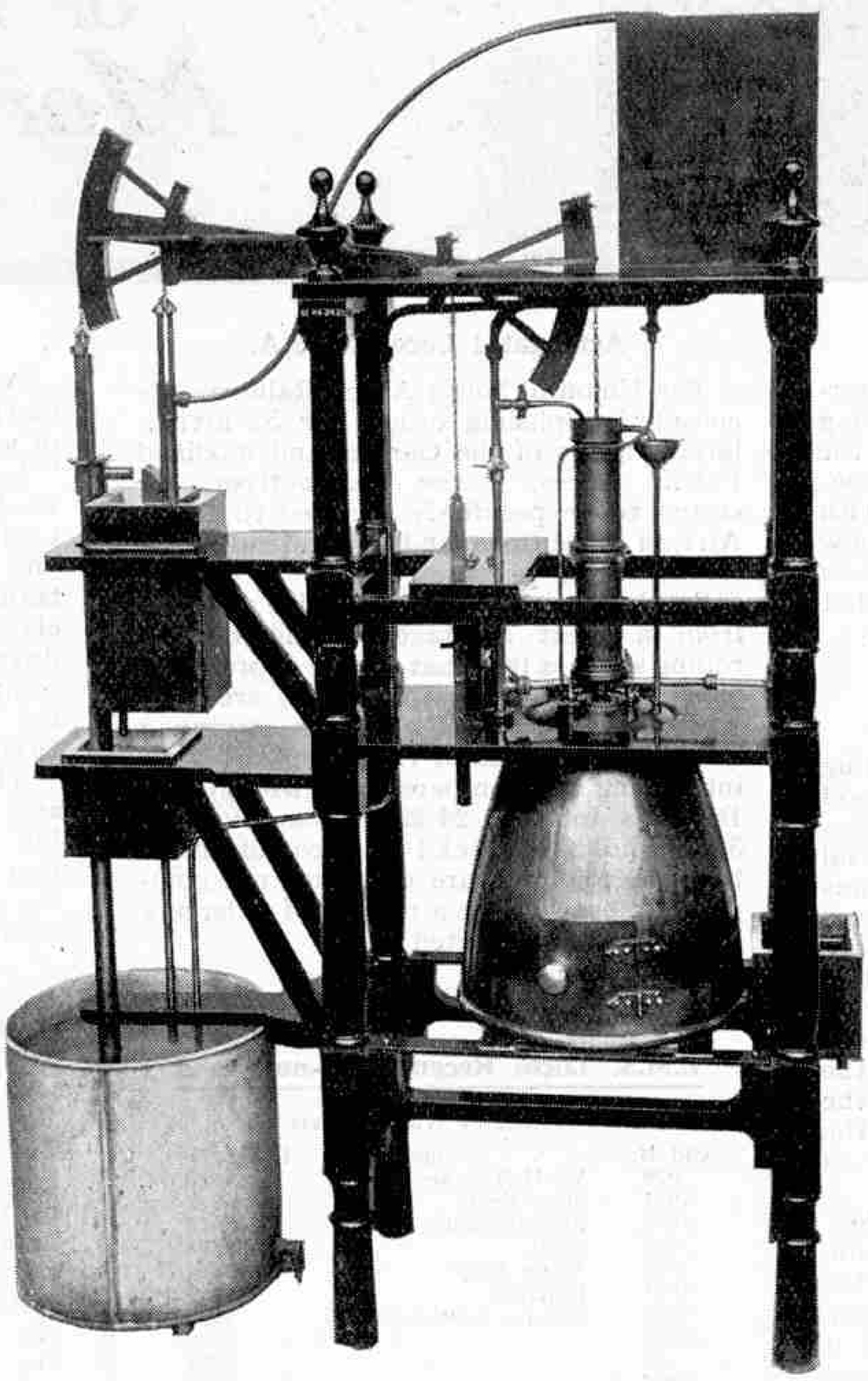
The Problem Solved

For a long time the solution evaded him. Then, one Sunday afternoon in the spring of 1765, while taking a walk across Glasgow Green and pondering over the unsatisfactory results of his experiments, an inspiration flashed upon his mind. Why not have a *separate* vessel in which to condense the steam? After doing its work the steam could then be passed from the cylinder into the independent chamber and there condensed by the injection of cold water. By this method the cold water would not be brought into contact with the cylinder at all, and the latter could be kept dry and hot during the brief period pending admittance of more steam.

Watt quickly realised that at last he was upon the right track and resolved to put his new idea to the test first thing next day. Indeed he could hardly wait for morning to arrive, and when at length it came he was up and about at an early hour, collecting the best materials he could for the momentous test.

First Real Steam Engine

A large brass syringe some ten inches in length and one inch and a third in diameter was borrowed and rigged up as a vertical cylinder. To prevent leakage of steam from this the exit of the piston rod was protected with leather packing. A hole was drilled down the stem of the piston and a valve fitted at the lower end, so that such steam as condensed on the first filling up of the cylinder could be drawn off independently of the condenser. From the roof of a small boiler a pipe led off and was connected to the top and bottom of the cylinder. A third pipe extended from the top of the cylinder to the new condenser, which had been roughly fashioned out of tinplate.



A working Model of Newcomen's Engine in the South Kensington Museum

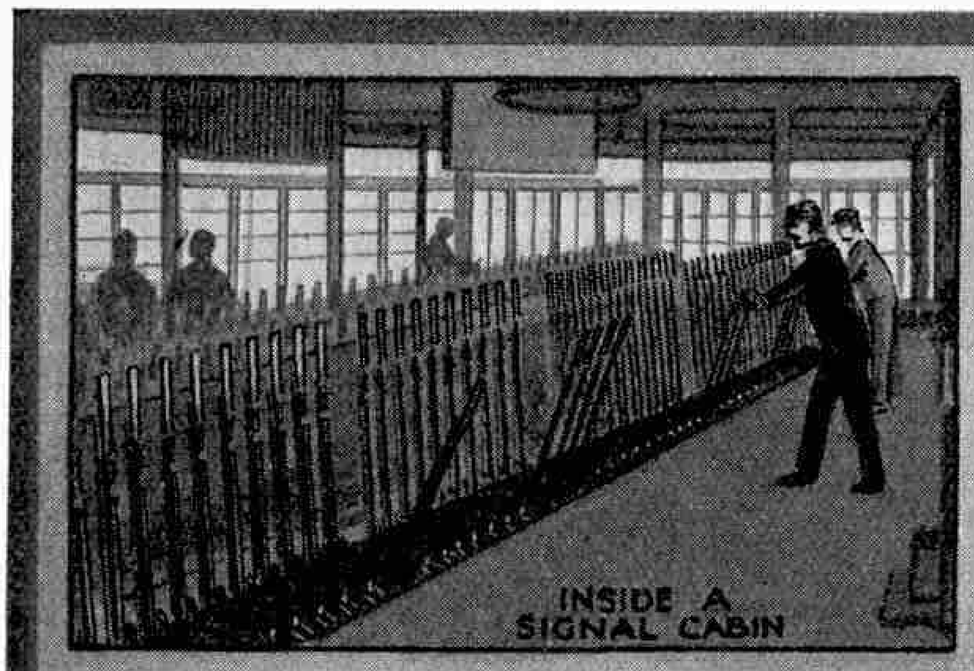
Two pipes leading down from this chamber connected with the foot of a small air-pump, an innovation Watt installed to draw off the injected water and condensed steam, together with any air that gathered in the condenser. The two pipes and the lower portion of the air pump were accommodated in a large tank containing sufficient cold water to reach just above the base of the condenser chamber. This reservoir ensured the condenser and pipes being kept cold.

Steam was generated and admitted to the cylinder, the air thus displaced escaping by way of the piston valve. When the steam was considered to be in complete possession of the cylinder the steam cock was closed. The piston rod of the air pump was then pulled up, the air in the condenser chamber and the pipes being drawn after it, leaving a vacuum. Upon the condenser cock then being opened the steam rushed in from the cylinder to be immediately condensed. The pressure upon the cylinder piston being thus removed, the latter at once rose, lifting an 18 lb. weight suspended from its lower end. The condenser cock was then shut and steam re-admitted at the top of the cylinder, forcing the piston down again, after which the process was repeated.

In the Newcomen engine, in which the downward stroke of the piston was the working stroke, resulting in the lifting of the pump-rod, *atmospheric* pressure was used to effect this important motion. Watt had now performed this function successfully solely by *steam* pressure, and thus brought into being the first true steam engine.

Hampered by Bad Workmanship

Watt's great invention was still far from perfect, however, but his initial success redoubled his enthusiasm and the subject of the steam engine now completely absorbed him. "My whole thoughts," he wrote in April, 1765, to a friend, "are bent on this machine. I can think of nothing else." His mind was already full of schemes for effecting needed improvements in the invention and the building of a (*Continued on page* 263)



Railway News of the Month

Diesel-Engined Rail Coaches

For some months past accumulator-driven rail coaches have been operating on the Cassel-Muenden section of the German railways and have proved conclusively their efficiency as compared with steam-driven coaches. Experiments now are being conducted with coaches driven by Diesel engines and it is anticipated that even greater economy will be secured.

* * * *

A Reversible Train

The L.M.S. are trying an interesting innovation on the Blackpool to Fleetwood local service. A train composed of a tank loco and one, two or three special two-coach units, as traffic requires, runs to and fro with the loco always at the same end of the train. When running with the loco at the rear the driver is stationed in a small compartment in the guard's van, and has charge of the brake, whistle, and apparatus for communication with the fireman, who of course remains on the loco. A row of windows in the end of the coach affords the driver a clear view of the track.

The coaches are coupled tightly together, forming practically an articulated train, thus increasing the smoothness of the running. The new system has been introduced in the interests of economy and it obviates the necessity for the spare locos that were formerly stationed at each terminus to haul the train on alternate journeys.—G. S. Marsh (Blackpool).

* * * *

New Colliery Railway Proposed

A proposal to construct four miles of railway track between Thorne Colliery and Goole is being considered by the proprietors of the colliery. A new loading wharf would have to be constructed at Goole to facilitate the despatch of the coal, but it is estimated that the transport charges between the colliery and Hull would be decreased by 1/6 per ton.

* * * *

Pullman Cars in Ireland

The Pullman Car Company have built ten third-class dining cars for use on the Irish Great Southern Railway. The cars have been constructed specially to the requirements of the Irish standard gauge, 5 ft. 3 in., and will be employed on the run between Dublin and Cork, and Sligo (via Millingar). The cars are not at present being attached to the Irish mail trains, and two are being held at the Inchicore Works (Dublin).

Articulated Locos for S.A.

The Union of South Africa Railways are considering placing orders for 52 articulated engines of the Garratt and modified Fairlie types. These locomotives are stated to be peculiarly adapted to South African conditions and are intended for mixed traffic purposes.

South Africa admittedly is suffering from a great shortage of engines and rolling stock, a fact that will be appreciated from the statement that there are only 1,940 locomotives of all types serving a total length of line of 12,000 miles. It is interesting to compare this with Great Britain's total of 24,221 locomotives for 52,000 miles of track! The conditions of the two countries are of course not comparable, but so wide a margin of difference is not easily accounted for.

L.M.S. Locos Recently Re-numbered

"Prince of Wales" Class

Old No.	Name.	L.M.S. No.
979	W. M. Thackeray	5630
1081	John Keats	5612
1089	Sydney Smith	5613
1132	Scott	5674
1134	Victor Hugo	5614
1721	Defiance	5607
2443	Charles James Lever	5638
1373	—	5702
67	—	5731
1408	—	5746
244	—	5774
293	—	5797

"Sir Gilbert Claughton" Class

154	Captain Fryatt	5931
260	W. E. Dorrington	5911
1159	Ralph Brocklebank	5906
1914	Patriot	5964
1172	Bunsen	5966
1092	—	5986
1216	—	6028

L.M.S. "Moguls"

For the benefit of inquiring readers, we would state that the three new L.M.S. "Mogul" type engines are working in the following districts:—No. 13000, from Derby shed, on the Midland Section, West of England line; No. 13001, from Manchester (Newton Heath) on the Manchester, Blackpool and Southport lines; No. 13002, from Bradford (Low Moor) on the Bradford-Manchester run principally, and frequently on London expresses between Bradford and Sheffield (Victoria). Occasionally, at weekends, No. 13002 works a Bradford-Blackpool excursion.

Seventy similar locos are to be built and the first of the new series, No. 13030, has recently been completed at Crewe.

L.M.S.-G.W.R. Engine Exchange

A series of private trials has taken place on the L.M.S. and G.W. lines, in the course of which the G.W. 4–6–0 engine No. 5000, "*Launceston Castle*," worked the L.M.S. Euston-Glasgow expresses over the Crewe-Carlisle section on alternate days, returning on the corresponding Glasgow-Euston train the next day. An L.M.S. Claughton class loco operated the run on the alternate days. A Midland Section L.M.S. 4–4–0 compound loco, No. 1047, has been working the "two hour" 1.15 p.m. Paddington-Bristol express.

The trials have now been completed and the locos returned to their own lines but as it was a condition of the exchange that the results were not to be published, we are not in a position to give further details.

* * * *

The New Epsom Station

There are two Southern Railway stations at Epsom, known respectively as Epsom and Epsom Town, the former serving the Western Section and the latter the Central Section of the company's system. To cope with the ever-increasing traffic and to provide a more economical system of handling it, a new passenger station is to be built on the site of the present Epsom station. It is proposed to concentrate the passenger traffic of both sections on the new station when it is completed and to use the old Epsom Town station for goods traffic only.

The estimated cost of the new works, which are to be carried out without interrupting the present services, is £90,000. Two island platforms each 650 ft. in length and 25 ft. in width are to be provided and a special loading dock, 200 ft. in length, will be built to deal with the considerable horse traffic.

* * * *

Heavier Engines for the North of Scotland

The bridge spanning the River Spey at Craigellachie, on the Great North of Scotland Section of the L.N.E.R. has recently been tested with a view to introducing heavier locomotives and avoiding double-heading of the through summer expresses over this section. In the past the heaviest engines used on the "Great North" have been 4–4–0's of very moderate dimensions, but in recent years there has been a considerable increase in traffic. One of the well-known two-cylinder 4–6–0's of the former Great Eastern Railway was used for the tests, which included the crossing and recrossing of the bridge many times at varying speeds, special observations as to strains set up during the process being taken.

16-in. Guns for H.M.S. "*Rodney*"

Recently the L.N.E.R. provided a special train to move a unique consignment of three 16-inch guns for the Admiralty. The guns were moved from the Elswick works of Sir W. G. Armstrong, Whitworth & Co. Ltd., to H.M.S. "*Rodney*," now approaching completion at Cammell Laird & Company's Birkenhead yard.

The train was composed of 4–6–0 type loco No. 932, two brake vans, six ordinary wagons, and three special sets of three trolley wagons, upon each of which a gun was placed. Each of the guns is 62 ft. in length and weighs 105 tons, the total length of the train being 143 yards and its weight 576 tons.

During the first portion of its run, the speed of the train was restricted to 20 m.p.h. and later was increased to 25 m.p.h. Owing to the exceptional weight of the train it was not allowed to be on any bridge at the same time as another train or engine while passing between Scotswood and Ouston Junction.

* * * *

80-Ton Trolley Wagon

A special vehicle designed to carry exceptionally weighty or bulky loads up to 80 tons has recently been introduced by the L.M.S. The wagon is 73 ft. 8 in. in length and, in order to distribute the weight as evenly as possible with the object of permitting the vehicle to be used on the older sections of the company's line—the axle load being limited by the strength of the bridges to be crossed—two bogies are fitted at each end of the trolley, the buffers and draw gear being fitted to the outer bogies at each end. The trolley is equipped with transverse and longitudinal baulks of timber for use in fixing and carrying the various loads, and the total weight of the trolley with the timber is 47 tons 13 cwt.

* * * *

Faster Lifts

Although the Underground Railways are equipping their stations generally with escalators, at certain points on the system the stations are too far below the ground for these appliances to be employed. Holborn and Leicester Square are cases in point, and to improve the service to passengers using these stations the speed of the lifts working between the street level and the line is to be increased from 180 ft. to 290 ft. per minute.

Southern Railway Improvements

The Southern Railway's programme of extensions for 1927 is now in hand, and despite the serious drop in the company's income during 1926, the work to be carried out indicates confidence in the outcome of the next few years.

The sum of £3,570,000 is to be spent on the electrification of the suburban lines in the central section, the current being supplied on the third-rail system.

A new station is to be built at Wimbledon at an estimated cost of £250,000 and reconstruction is to take place at Dover Priory station to provide improved facilities for the handling of the Continental traffic, involving the doubling of the line into the Marine station over which the boat expresses pass.

Work on the Southampton Docks extension scheme will be pushed forward and various improvements to the permanent way, either by widening of main lines or the provision of new loops, will be put in hand.

In addition £700,000 is to be spent on the provision of new locomotives and rolling stock and ten 4–6–0 type engines of the "King Arthur" or the "Nelson" class will be constructed. Five 4–6–0 engines, twenty 2–6–4 "River" class passenger tank engines, and eight 0–8–0 shunting engines are scheduled in the programme, which also includes 70 bogie corridor coaches and 1,500 goods and cattle wagons.

Following the Southern Railway's usual custom, it is proposed to place the contracts for the new work entirely with British firms.

* * * *

The Central of New Jersey Railway Company's new bridge over Newark Bay was opened recently. Noteworthy in that it has what is believed to be the largest opening span in the world, the bridge consists of two parallel double track bridges, each 7,411 ft. in length. The new bridge has been built to replace that built in 1863.

An Unusual Load

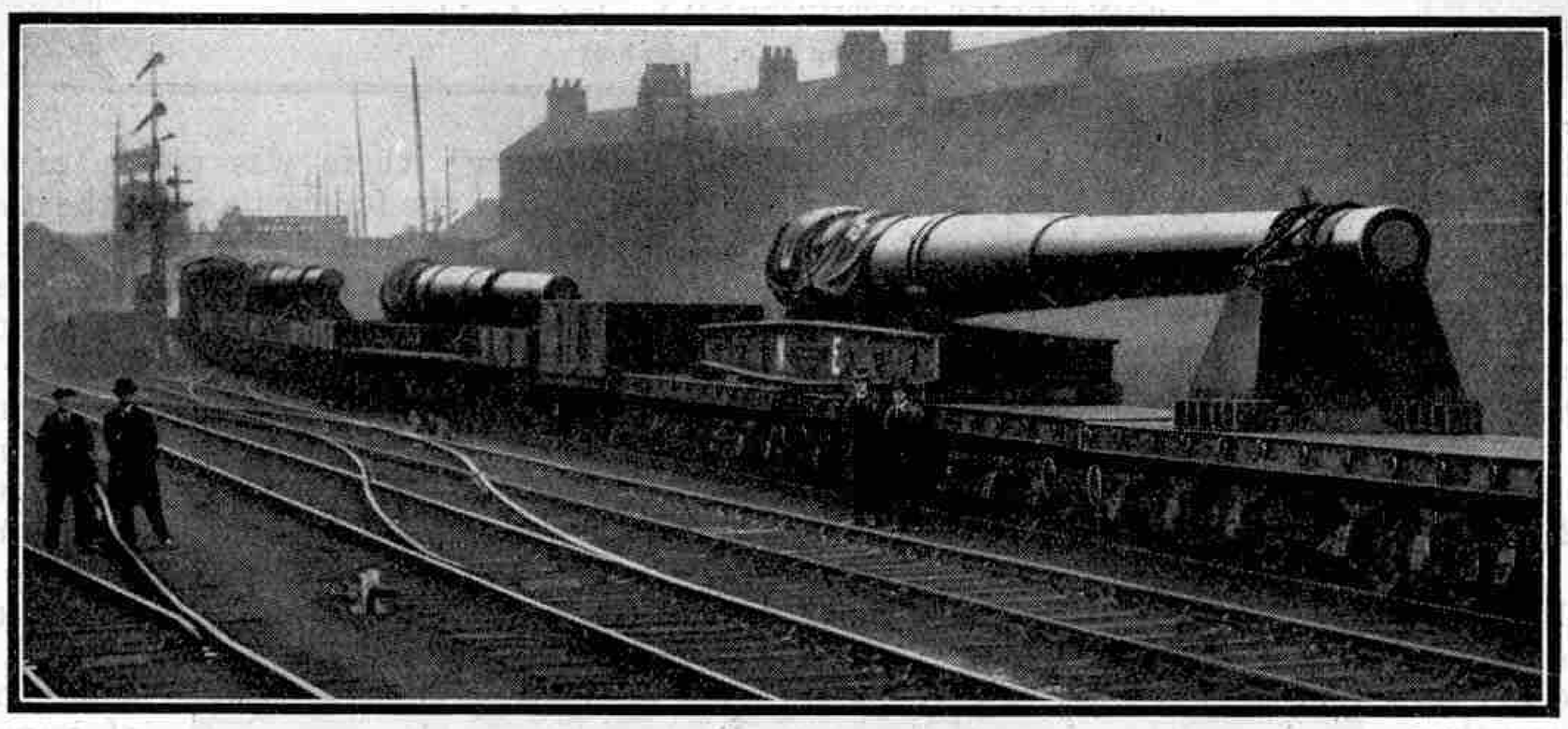


Photo courtesy] [*L.N.E.R.*

Three 16-in. Guns were recently moved from Elswick to Birkenhead, by special sets of three trolley wagons, as described on this page

Railway Track Cleaner

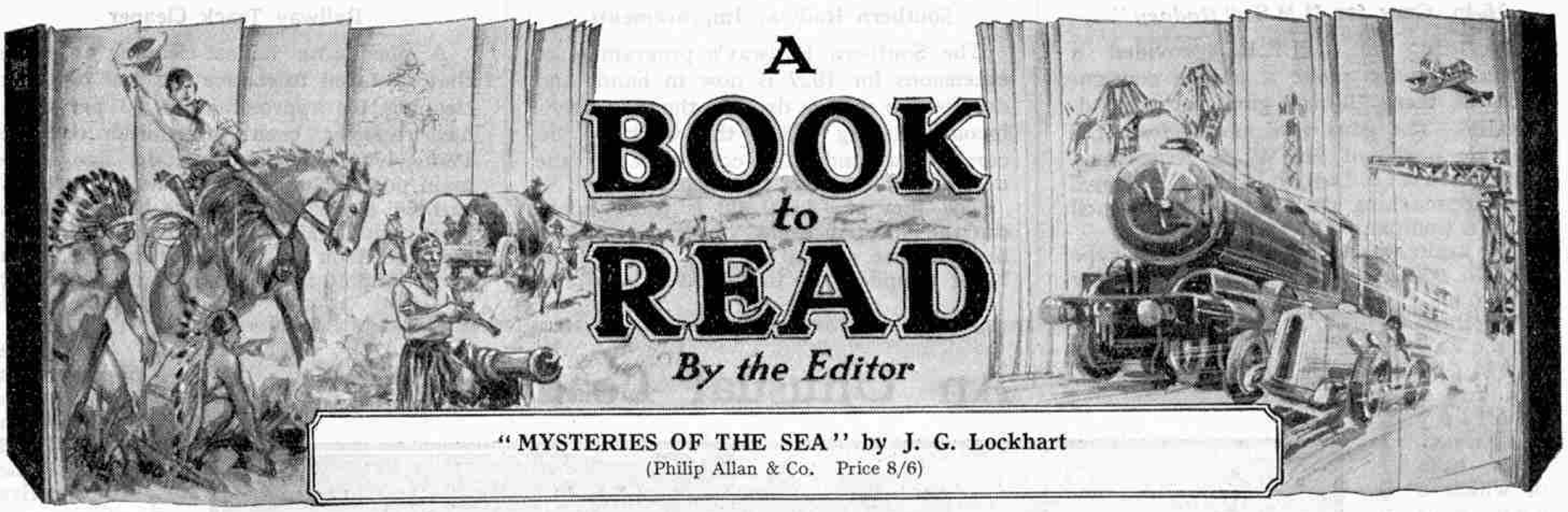
A pneumatic ballast-cleaning machine that is stated to reduce the cost of track cleaning by approximately 50 per cent. has recently been introduced on the Pennsylvania Railroad main line. The main portions of this machine are a steam turbine, a positive pressure blower and a large cylindrical expansion chamber, which are placed on a special flat car, 48 ft. in length and 10 ft. in width, with a carrying capacity of 150,000 lb.

When the machine is in operation steam supplied from the locomotive at a pressure of 205 lb. per sq. in. operates the steam turbine at a speed of 2,050 r.p.m. The turbine works a worm-gear reduction unit through a flexible coupling and this drives the positive pressure blower at 175 r.p.m. The blower produces 20,000 cu. ft. of air per minute and forces it through the expansion chamber at a speed of 18,000 ft. per minute. At the further end of this chamber are three steel pipes which, when dropped to the track level, can suck up the ballast to a depth of 17 inches below the track surface.

The first step in the track-cleaning operation is to loosen the ballast, which is performed by three steel forks that are lowered from the middle of each side of the car. The car then travels forward at a speed of approximately 10 miles per hour over the length of track to be cleaned. When the forks have loosened the ballast, they are drawn up to the body of the car and the three steel pipes previously mentioned are lowered to the track and the blower is set into operation. Under the powerful suction produced, the ballast, together with all the refuse on the track, is drawn up at the rate of approximately 150 tons per hour into the expansion chamber, and is then thoroughly cleaned by air.

The whole machine is gradually travelling back over the track while this operation is going on and the cleaned ballast is discharged along the side of the rails through two slowly moving air locks. The speed of the operation can be judged from the fact that from the moment that the ballast leaves the track until it is deposited, cleaned and separated from dirt and refuse, at a point 12 ft. away from its original position, only 12 seconds elapse.

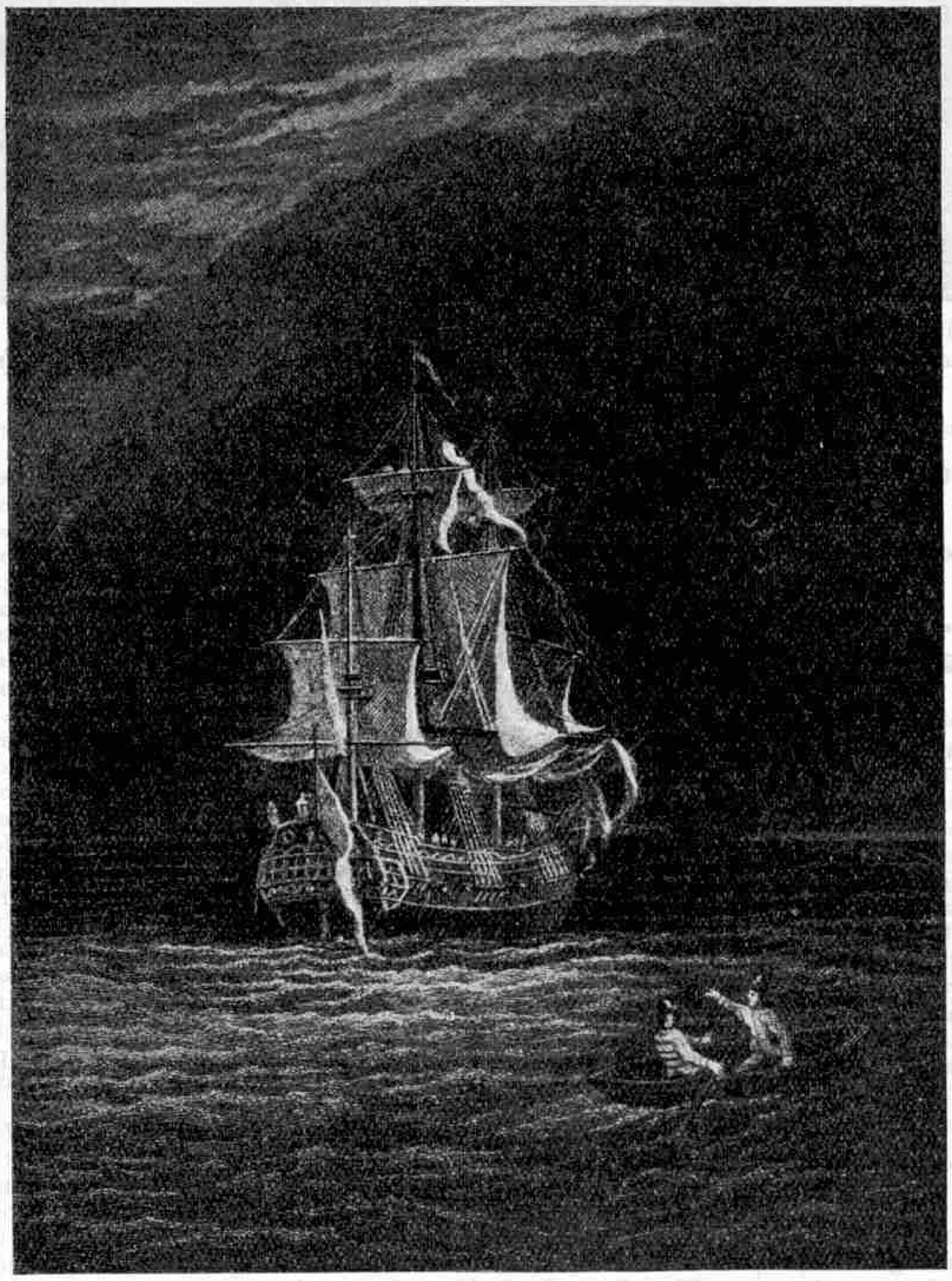
Only two men are required to operate the machine, in addition to those employed on the locomotive, and one mile of track can be cleaned in ten hours.



"MYSTERIES OF THE SEA" by J. G. Lockhart
(Philip Allan & Co. Price 8/6)

PERHAPS there is no more greater mystery of the sea than the strange case of the "*Mary Celeste,*" without an account of which any book such as the one mentioned above would naturally be incomplete. The facts of this extraordinary happening are briefly as follows. About three o'clock in the afternoon of the 5th December, 1872, a vessel overhauled a strange brig in the middle of the Atlantic. She signalled to her but received no reply, and this, together with the fact that the brig was sailing in a strange manner and running aimlessly before the wind, caused the captain of the overtaking ship to think the crew must at least be below and drunk. As the two ships approached closer there was not a soul to be seen on the strange ship's deck, and when the captain hailed the brig no answer came from the silent deck. A boat was lowered and from the name on her stern the stranger was seen to be the "*Mary Celeste,*" New York.

The captain and the mate clambered aboard but could see no one—there was no one at the wheel and no one on deck. The ship was sailing by herself and not a sound was to be heard but the creaking of the plugs and the occasional slap of a sail. The vessel was searched from end to end but not a soul was found and nothing that could throw any light upon the mystery of the crew's disappearance. To all appearances the ship was in perfect condition; the cargo was well stowed away and in good order; there was plenty of food and water aboard, and in the forecastle were the seamen's chests of clothing dry and undisturbed, some underclothes being hung out to dry on a clothes line. In the cabin the table was laid for breakfast, and the meal had been apparently half eaten but hurriedly deserted for on one of the plates was some porridge and the top of an egg had been sliced off ready for eating. In the mate's cabin there was a piece of paper with an unfinished sum on it, which the mate had evidently been doing when he was interrupted by something. An examination of the ship's log showed no hint of tragedy. The last entry was made eleven days previously, yet that the ship had held to her course unmanned and unsteered for ten days was an almost impossible belief, as to do so she would have had to cover 400 miles in difficult circumstances.



Marryat's Phantom Ship, known also as the "*Flying Dutchman,*" one of the famous mysteries of the sea

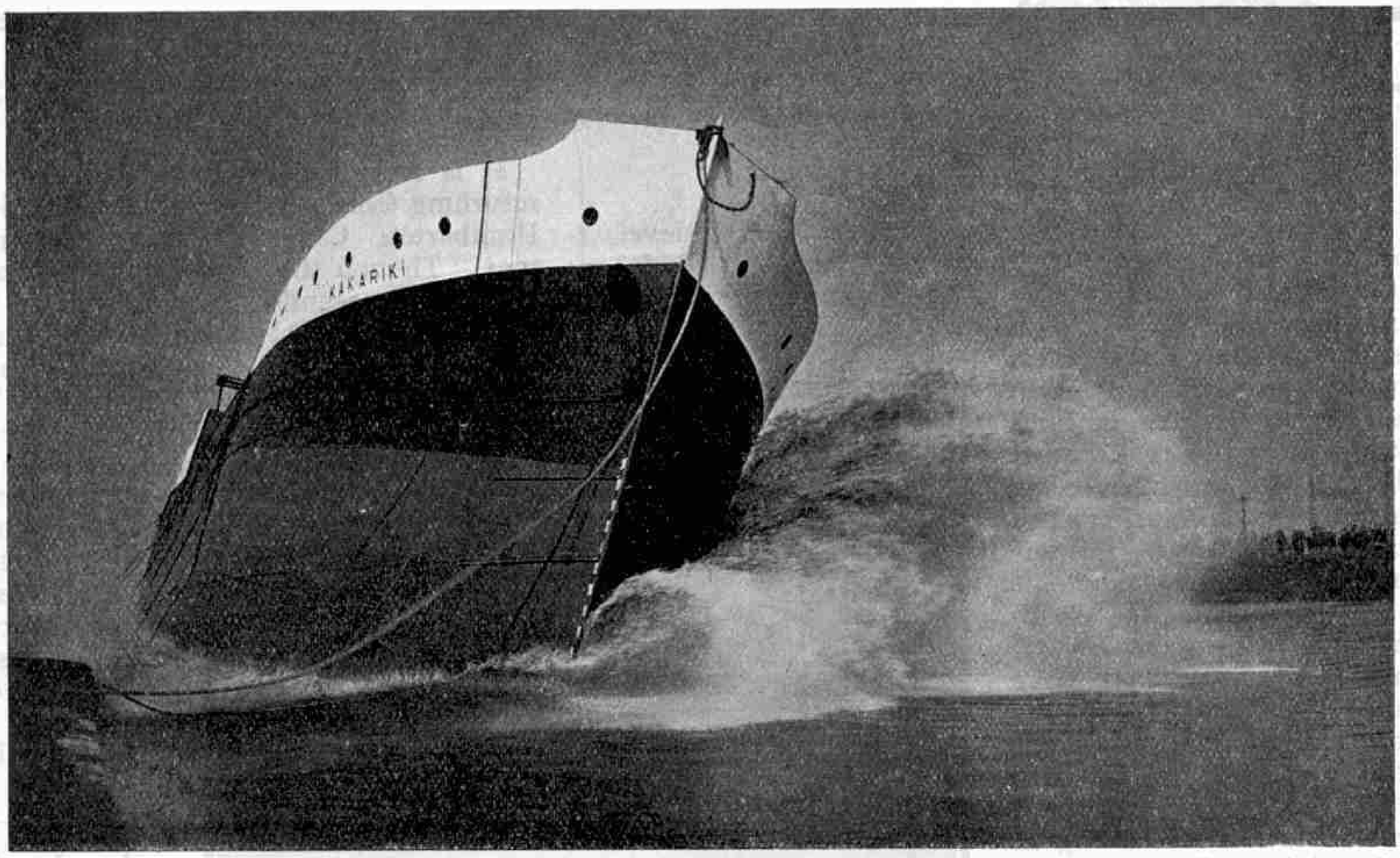
The "*Mary Celeste*" was brought into Gibraltar a few days later and on arrival was handed over to the authorities. She was examined by surveyors and divers and found to be sound, and no reason was evident as to why the ship should have been abandoned.

Many curious explanations have been given at different times by different people, including suggestions that the ship had been attacked by some huge sea-monster; that a strange ship needing a crew took off the crew by force; that a cloud of poisonous gas, (*Continued foot of next page*)

Launching a Ship Sideways

An Interesting Cargo-Carrier for the Antipodes

ONE of the most interesting cargo-carriers launched last year was the "*Kakariki*." This vessel was built by Cochrane and Sons Ltd., of Selby, Yorks., to the designs of William Esplen, Son and Swainston Ltd., of London, for the Union Steamship Company of New Zealand Ltd. She was built for service between south-east Australia, New Zealand and Tasmania, and was specially designed for the carriage of concentrates, bulk and general cargo.



Courtesy ["*Shipbuilder*"

The "*Kakariki*" taking the water sideways

The "*Kakariki*" is of the single-deck type with topgallant forecastle and bridge erections. Her overall length is 198 ft. 6 in. and her breadth moulded 31ft. 6 in. A double bottom extends throughout the length of the hull except under the boilers, the capacity for water ballast being 290 tons.

The propelling machinery, built by Amos & Smith Ltd., of Hull, consists of a set of single-screw triple-expansion engines with cylinders 16 in., 27 in., and 44 in. diameter by 30 in. stroke. Steam is supplied by two Scotch boilers of 11 ft. 6 in. internal diameter by 10 ft. 6 in. mean length, burning coal and working under natural draught at 180 lb. pressure. These engines develop 750 I.H.P. at from 86 to 90 revolutions per minute under normal conditions, but while the vessel was undergoing her sea trials the engines developed 910 I.H.P. at 105 r.p.m. Elaborate accommodation is provided for the officers and crew.

There are two cargo holds, each served by a hatchway 27 ft. 6 in. in length by 16 ft. wide, each hatchway having two steel tubular derricks each capable of handling normal working loads of five tons. The deck machinery includes four steam winches, steam windlass, steam capstan and steam steering gear.

As our photograph shows, the "*Kakariki*" was launched sideways, and it may be mentioned that at the time of her launch, she was one of the largest vessels to be launched in this manner in this country, although a second, and larger, vessel has been launched in a similar manner by the same firm more recently. The photograph gives an excellent impression of the scene at the moment the vessel entered the water.

A Book to Read—(*continued from previous page*)

discharged by a submarine explosion, enveloped the ship and caused the whole of the crew to leap into the sea! These theories are ridiculous on the face of it, however, and are not in accordance with the facts. A more likely theory was that the crew had mutinied, but this was soon relinquished, for the ship's cash box was intact and in the cabin was gold and jewellery. Then again, how could the mutineers have escaped from the ship for the "*Mary Celeste's*" boat hung on its davits! Circumstances pointed to the whole of crew having been taken off by a passing vessel or to them having jumped overboard, but if either of these theories is correct, what possibly could be the explanation of their action? Nothing whatever has been heard of the Captain, the crew, or the Captain's wife and daughter, who were passengers on board. The occurence was a mystery when the "*Mary Celeste*" reached Gibraltar and it remains a mystery to this day.

No writer of fiction could succeed as well in stimulating the imagination of the reader in search of mystery as does this "Book of Strange Tales," founded on fact. From the first chapter of the book, "Who Discovered America," to the final chapter, "Lord Kitchener's Last Journey," I have been thrilled with tales of phantom ships, mysterious disappearances, and sea-serpents, such as those with which the men who "go down to the sea in ships" have delighted the boys of every age.

It is a fascinating theme and the story is told in a thrilling manner—the best of it all is that they are all true. The volume is, indeed, a striking instance of the veracity of the saying that "Truth is stranger than Fiction!"

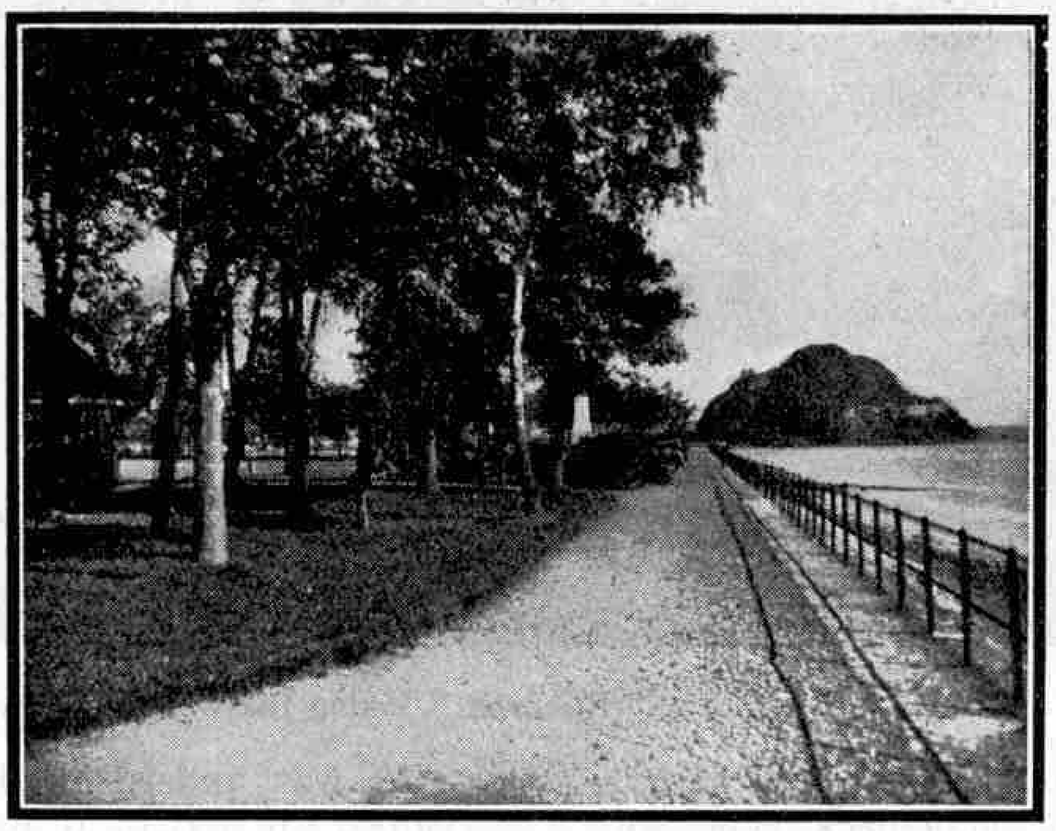
FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Dumbarton Castle and Rock

The historic rock of Dumbarton stands on a level plain at the confluence of the rivers Leven and Clyde. Its greatest height is about 206 ft. above sea level and it is one mile in circumference. Seen from the esplanade the castle is a very impressive sight. In summer it is like a faint water-colour painting against the sky, and in winter it is a magnificent spectacle when its rain-lashed side glistens in the morning sunshine.

At a place called the Washing-stone Green lie several masses of stone that have fallen in past ages. The name originated from the tradition that the weekly wash was carried out here by the housewives living in the vicinity. To this place, from the castle gates, walked Mary Queen of Scots to embark for France and, we are told, through these same gates Wallace was taken on his way to execution. At different heights on the castle are pieces of old cannon of the time of George III., commanding the long stretch of the Leven and the Clyde and the town itself. Near the top of the rock a small circle of stones and grass marks the remains of a tower that was known as Wallace's Tower.



The Esplanade and Rock, Dumbarton

From the top looking northward, on the plain directly below, lies the town of Dumbarton. Beyond stretches the valley of the Leven and, in the distance, the gloomy outline of Ben Lomond looms faintly against the sky. Two miles or so away lies Renton, the birthplace of Tobias Smollett, the novelist. Looking eastward a fine view of the Clyde valley is obtained. On the left may be seen Dumbuck Hill.

Legend says that when St. Patrick (believed to have been born in the parish of Old Kilpatrick, a few miles away) was leaving for Ireland, the devil wrenched a huge piece of rock from this hill and threw it with curses at the saint. Happily it missed its mark and landed on the water's edge. That piece of rock is now known as Dumbarton Castle.

It is interesting to note that in 1773 Dr. Johnson, returning from his tour in the Hebrides, paid a visit to Dumbarton Castle. His biographer Boswell states that "Though the approach to the castle is very steep the doctor ascended it with alacrity and saw all that was to be seen." McLeod, the historian, tells a different story. "In my boyish days," he says, "a tower in the north-eastern corner of the high castle wall was shown in the doorway of which the portly doctor stuck hard and fast, and that was put forth as the reason why Boswell recorded so little in regard to their visit to the famous fortress and rock of Dumbarton!"

JOHN DUNLEAVY
(Dumbarton).

At the Waterworks

A short time ago our school scientific society were invited to pay a visit to the Amersham Waterworks and we accepted this invitation with enthusiasm.

On arrival at the works we were shown first the anthracite coal that was to be made into gas to drive the engines. Owing to the strike this coal was foreign and, we were informed, very bad! Next we entered the department in which the gas was made from the coal and purified.

Our next destination, the engine room, was the most interesting of all. Three powerful Crossley suction gas engines drove the pumps that lifted the water to the tower and reservoir at Coleshill. These engines are started by compressed air provided by a compressor driven by a small Crossley engine. The size of the main gas engines impressed us all very greatly.

We were then taken into a small office in which were interesting instruments showing the depth of water in the reservoir and in the tank on the tower. The tower is 70 ft. high and holds about 70,000 gallons of water. We climbed up the interior and as there were "landings" across the centre at intervals we could have rested if we had wished, but we were too eager to reach the top, from which the view was splendid. We were duly impressed

Pottery Transport in Egypt

by the size of the reservoir, which is covered. We were told that before it was built the overflow from the tank led to a farmyard which was practically swamped! H. FULLER (Amersham).

My Everyday Thrills

I go to school in London but live 20 miles away, so I am lucky enough to travel on the G.W.R. Even if I miss a train at Paddington in the evening there is plenty to see on the platform with the long trains. Sometimes the staff are busy getting a racehorse into its box, and a fine job they have! Often there are parties of sailors for Devonport and Plymouth. Little electric trolleys piled high with luggage rush about feeding the huge vans of the expresses, and food and various articles of crockery are being loaded into the kitchen cars.

Then my train is off, hauled by a 4–6–0 loco. We pass over a mass of lines under some large girder bridges, past the milk platform and the engine sheds, and then branch off at Old Oak Common. We then start to increase speed to about 40 m.p.h., passing Messrs. Lyons factory at Greenford and Northolt Wireless Station in a flash. Soon we join the L.N.E.R. (G.C. Section) and at Denham we pick up water.

The journey often has some excitement, in fog or when an accident has happened. Once we were pulled into a siding and a breakdown train rushed by with two vans, a steam crane and trucks. Our engine driver told me that this train was travelling at well over 60 m.p.h. and all traffic would have to get out of its way. He told me also that once a breakdown train went so fast that it came upon the scene of the accident before it could stop, and piled itself up on top of the already wrecked coaches!

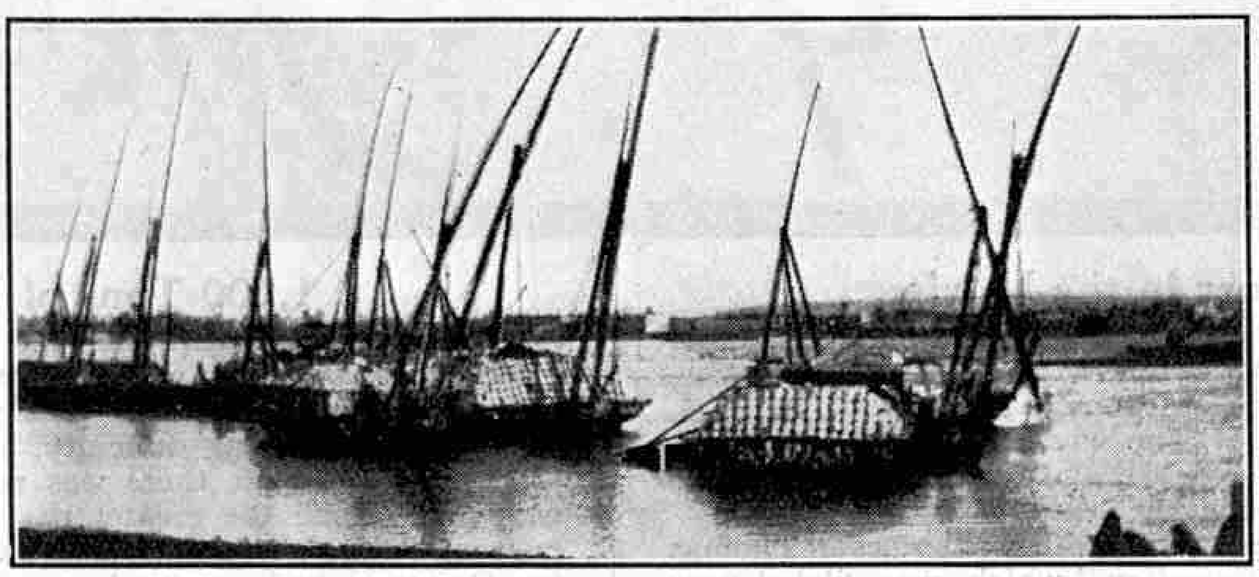
The equipment of a breakdown train is designed to cope with almost any conceivable emergency. First of all there is a powerful crane that is capable of lifting even the heaviest locomotive. Then there are lifting jacks, spades, crow-bars and a host of other tools and implements, each specially designed for its own particular job. Unfortunately, railway accidents are liable to be accompanied by more or less serious injury to railwaymen or passengers and therefore the outfit of the breakdown train includes an ample supply of the various articles likely to be required by doctors. The men constituting the breakdown gang are specially picked and trained and most of them have a sound knowledge of first-aid work, which is very valuable in emergencies.

F. G. KAY (Gerrard's Cross, Bucks.)

Pottery Transport in Egypt

The boats seen in the accompanying photographs are used for the transport of pottery in Egypt. They make their appearance only during the period June to August during which the river Nile is in full flood and there is sufficient depth of water to cover all obstacles.

Pottery clay is abundant in Aswan Province and pottery is manufactured there. These special boats take this pottery down the Nile to Lower Egypt at a very cheap rate; so cheap in fact that in Cairo you can buy a full-sized water vessel for half a piastre, equal to $1\frac{1}{4}$d.



Native boats on the Nile laden with Pottery

The pottery boats are flat and have strong rope nets at each side, and by a special arrangement the pottery vessels in these nets are made to serve as buoys and lift the boat, at the same time increasing its deck area.

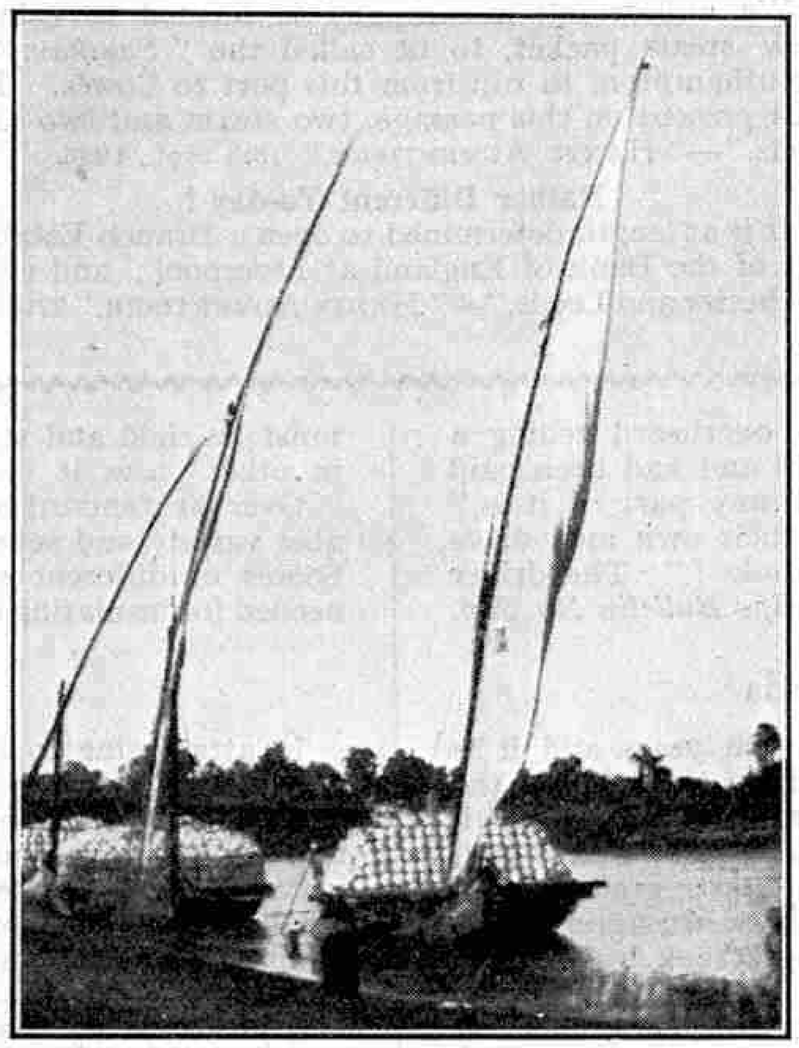
ALY A. SHAWKY (Cairo).

A Trip on a Tug

While on a holiday at Brixham I made friends with the Captain of the tug that is stationed there to bring into the harbour big coal ships that come from Cardiff. One day while I was chatting with the Captain the long-drawn-out wail of a ship's siren came across the water. Instantly the crew jumped aboard and as the Captain told me I might go I jumped aboard also.

Soon we were off to the entrance of the harbour and as we rounded the end of the breakwater we saw steaming towards us a huge coal boat. In a few minutes we were alongside, our tiny tug appearing somewhat similar to a mouse beside a lion. From the ship was lowered the end of the biggest rope I have ever seen and this was quickly and securely fastened to the tug.

Away now went the tug until the rope tightened and we stopped with a jerk. Little by little, however, the tug made headway and slowly the ship was led into harbour and moored by the side of another vessel, into which she began to discharge her cargo. Huge cranes were set into position and buckets holding 30 cwt. of coal passed to and fro between the two vessels. During this process the services of the tug were not required and she therefore steamed back to the jetty to wait until the coal boat was ready to be led out again to the open sea.



The boats fastened up on the banks of the Nile

It is rather interesting to know that the first steamship to have been employed for towing other vessels was probably the "*Majestic*" which, in August, 1816, towed an "Indiaman" from Deptford to Woolwich, against the wind, at the rate of three miles per hour.

R. COOMBES (South Leigh).

Of General Interest

Western Farmer in the Movies

After a man has used a wagon on one of the wheat farms around Calgary for five years and has left it outdoors for five winters, it is no longer a thing of beauty and, though it may still be useful, it is certainly not ornamental. The wheels wobble as they go round, some of the boards are cracked and traces of paint can be discovered only by long and diligent search.

Such a wagon, however, figures in a number of scenes in Thomas Meighan's new picture "*The Canadian,*" which was filmed near Calgary amid the prairie country traversed by the Canadian Pacific Railway. A "prop man" hired the venerable conveyance and two horses from a farmer about 40 miles north of Calgary and for two weeks the farmer accompanied it from place to place and reported for duty when called. He received nearly £4 a day for his services and was satisfied. At the end of the second week the prop man decided that particular wagon would be needed to complete some of the scenes at the Long Island Studio and the farmer was asked if he would sell. He wanted to know what they would do with a wagon like that in New York and, without a smile, the prop man answered: "Oh! we sometimes have to go down to the station to bring the actors' trunks up to the studio!" After two days' negotiations, the farmer agreed to sell the wagon for £20 and the harness for £5. Later on he was overheard telling a neighbour how he had sold the outfit for £25 and had been paid over £50 for fourteen days' work. "The funny part of it is," he explained, "that they even had one of their own men drive the wagon for me. All I had to do was smoke!" The driver was Thomas Meighan himself.—*Canadian Pacific Bulletin No. 216.*

Over a Hundred Years Ago!

"Meat in Holland is 2d. per pound, notwithstanding that 16,000 cows perished by the inundation last year. The price of fresh butter is only 4d. per pound. Potted 5d."—"THE TIMES," 8th April, 1826.

Was this the First Iron House?

"A journal of Lyons announces that a house is in a state of forwardness, to be built entirely of cast iron."—"THE TIMES," 1st Nov., 1826.

"Small Beginnings . . ."

"We understand a company is formed to establish a new steam packet, to be called the "*Southampton*" of Southampton, to run from this port to Cowes. There are at present on this passage, two steam and two sailing vessels."—"HANTS ADVERTISER," 15th Sept., 1826.

Rather Different To-day!

"It is at length determined to open a Branch Establishment of the Bank of England at Liverpool; and also at Manchester and Leeds."—"HANTS ADVERTISER," 27th Nov., 1826.

The Riddle of the Sands

Musical sand has been known for over 1,000 years and it is believed that there is a reference to it in one of the tales of the Arabian Nights. The best musical or singing sand in the world, which comes from the Island of Eigg, off the coast of Scotland, is composed of rounded and highly polished quartz grains, being of a uniform size and very clean. When these are agitated by the wind, by being trodden on, or by being struck by a stick, they produce musical notes.

There are many other examples of musical or singing sand in various parts of the world, as, for instance, the Mountain of the Bell, on the shores of the Red Sea, which makes extraordinary musical sounds when the winds stir up the countless millions of particles in the sandy desert surrounding it. Also, Darwin drew attention to the "Roarer" in Chili, which makes tremendous booming noises.

"Some" Cranes!

Considerable excitement may be expected among engineers when they read that the "*Celtic*" has taken out to New York eight cranes, the total value of which is only £60! These are not Meccano models, but West African Crown cranes, destined for the Zoological Park in New York!

1,200 Tons of Nails a Week

The normal consumption of ordinary wire nails in Great Britain is about 1,200 tons per week, a huge figure that indicates the value of our home market, supplies for which are maintained under ever increasing difficulty, according to the manufacturers.

Prior to the War there was no such thing as a British wire nail, and during the greater part of the War, wire nails poured in from America in increasing quantities and at increasing prices, for Germany had cornered one of the most universally useful articles that industry produces.

80 Insulating Materials

The substances most commonly used as insulators to-day include glass, slate, marble, paper, cloth, enamels, mica, porcelain, asbestos, varnishes, moulded compounds, rubber, mineral and vegetable oils, asphaltic and resinous filling or treating compounds.

All these substances may be used in several ways for insulating purposes. For example, mica insulation is made either with white mica, pure mica, or amber mica. Sometimes it is rigid, sometimes flexible. At times mica is cemented to paper to form composite insulations. Insulating varnishes, also, may be either black or clear, air-drying or baking, soft and flexible or hard finishing.

For some purposes insulation must be rigid and strong, to serve also as a supporting medium; in other cases it must have the greatest possible flexibility.

Over 80 standard tests of insulating materials reveal the remarkable variety and severe insulating requirements that exist to-day. Scores of different substances and hundreds of forms are now needed for insulating copper and iron in modern electrical machines.

Children for Sale

In attempting to sell her child for 3/6, a transaction promptly stopped by the Mayor, an Agincourt woman has been following a custom formerly quite common among the poor of many countries, and not always unknown even in England. In the year 1017, for instance, King Canute found it necessary to issue an edict forbidding English parents to sell their children as slaves to the Irish. They managed these things better in ancient Egypt, where the unwanted child had only to be exposed on the banks of the Nile to be adopted and protected by the State.—"*Liverpool Post.*"

Shillings Not Necessary at Heathfield!

At Heathfield Station in Sussex there is a unique source of gas supply for lighting purposes. The station, which is on the Southern Railway, is lit with natural gas that comes directly out of the ground through a pipe and is collected in a holder.

The Government has recently become interested, and 60,000 cubic feet of gas is being supplied to the Ministry of Mines, Research Department. This is sent in cylinders containing 80 or 100 cubic feet, the gas being compressed by a special machine.

The light given is a brilliant one, the heat thrown out is far superior to ordinary coal gas, and there is no smoke or dirt. Lucky Heathfield!

World Tour on Motor Cycles

Two Belgian motor-cyclists, Henri Audrieux, an engineer, and Robert Sexe, a journalist, recently landed at Liverpool on the last section of a world tour. They left Paris on 13th June and having passed through Berlin, Moscow, Siberia and Japan, crossed the Pacific by steamer to San Francisco. Following the Santa Fé trail, they crossed America on their machines and embarked for Europe on the White Star liner "*Celtic.*" In the course of the tour over 25,000 miles have been covered, 12,000 of which were actually traversed in the saddle.

The most difficult portion of the journey was over the Siberian Desert between Moscow and Vladivostok, where for thousands of miles the route lay along almost unrecognisable tracks. Peasants in the Siberian villages were intensely interested in the motor cycles, believing them to be the new ploughing machines that they had been promised by the Soviet Government.

The two Belgian motor-cyclists who have made a tour around the world, as described on this page, photographed at Liverpool

A Shortage of Shillings

A shortage of shillings was recently experienced in many parts of London and in some residential centres in the provinces. The scarcity was attributed to the coal shortage, which necessitated a largely increased consumption of gas in hotels and boarding-houses, where bedroom gas-fires with shilling slot meters have been widely installed.

The enormous number of gas-cookers, gas-fires, and other heating appliances installed since the early days of the coal stoppage has absorbed hundreds of thousands of shillings. Further contributory causes are undoubtedly the cold weather and the temporary increase in the price of gas in some districts. The earlier lighting-up time has also had its influence.

Arrested for Wearing a Top-Hat!

An old journal, dated 16th January, 1797, gives the following amusing account of the wearing of the first silk hat in London:

"John Hetherington, haberdasher, of the Strand, was arraigned before the Lord Mayor yesterday on a charge of breach of the peace and inciting to riot, and was required to give bonds in the sum of £500. It was in evidence that Mr. Hetherington, who is well connected, appeared on the public highway wearing upon his head what he called a silk hat (which was offered in evidence)—a tall structure having a shiny lustre, and calculated to frighten timid people.

"As a matter of fact, the officers of the Crown stated that several women fainted at the unusual sight, while children screamed, dogs yelped, and a younger son of Cordwainer Thomas, who was returning from a chandler's shop, was thrown down by the crowd which had collected, and had his right arm broken!

"For these reasons the Defendant was seized by the guards and taken before the Lord Mayor. In extenuation of his crime the Defendant claimed that he had not violated any law of the kingdom, but was merely exercising a right to appear in a headdress of his own design—a right not denied to any Englishman."

Toll for the Brave

The next time your dad takes out his driving licence he will have handed to him a little buff booklet, bearing the title "Road Sense." The preface opens thus: "Over 115,000 persons were killed or injured in road accidents in Great Britain during 1925. The toll of the road is now over three times as heavy as it was seven years ago." It has been estimated that in America one person is killed every year for each 1,000 motor licenses, whereas in this country the proportion is one for each 300 licenses.

Where Robin Hood Lived

"Take the train to Nottingham, and, if an old inn with rambling passages, dark staircases and big open fires in the bedrooms is to your taste, then put up at the "Flying Horse," the only ancient hostelry left. You may need a guide every time you try to find your room, but that will only make it more enchanting, and help you re-people the countryside about you with Robin Hood, Maid Marian, Friar Tuck, Little John, and all their merry men in place of the coal miner and factory girls of to-day.

"The Forest of Sherwood is almost gone, but some of the great mansions in this part of the country must have trees in their secluded parks that stand where the old outlaw flung his horn's note through the glades. Some of the old woods can be seen still at Birkland, Bilhalgh, Mansfield Wood, part of Harlow Wood and Sansen Wood. Some famous old trees can yet be seen like the Major Oak near Edwinstone, with its trunk thirty feet round, and others called "Robin Hood's Larder," and the "Duke's Walking Stick." Whether Robin ever lived or not, for six hundred years and to-day he is the familiar friend of all the folk in this region, especially of the poor, who never forget that the Lincoln Green frightened all who dared to oppress them."—E. R. Petrie, in "*My European Excursions.*"

Fur Farms in Canada

"Fur Farming" in Canada is rapidly becoming an important industry and a great many shipments of valuable foxes from these farms are being made to foreign countries. Statistics show that in last year 5,590 live foxes, valued at nearly £300,000, were shipped to the United States, Great Britain, Belgium, France, Germany, Newfoundland, Norway, Switzerland, Finland, Japan and Russia. For example, 26 silver-black foxes were forwarded recently from British Columbia to France by Canadian Pacific Express, to be placed in the new fox ranch at Grenoble; and 30 foxes, bred in captivity but untamed, were sent from Kingston to Helsingfors, Finland; again 37 Manitoba-raised silver foxes have been purchased from Winnipeg, by fox breeders in Sweden—they are valued at £3,000.

Saskatoon, Sask., has five silver fox farms in flourishing condition, each having from 100 to 300 silver-black foxes; and two new fox farms were established in the Creston district of British Columbia about a month ago. The industry is being taken up all over the country and there is certainly money in it.—*Canadian Pacific Bulletin, No.* 216.

Oil from Grape Seeds

A new method of extracting oil from grape seeds has been discovered by French chemists. After the grapes have been pressed the seeds are removed from the skins, and dried. They are then subjected to a special process to extract the oil.

It is stated that this oil possesses lubricating properties similar to those of castor oil, and that it may eventually replace the latter as a lubricant for high-speed petrol engines such as those of racing cars and aeroplanes. Grape-seed oil is much cheaper than castor oil, the latter having to be imported from India.

Factories have been established in several districts in France for the purpose of commercialising this discovery. It is stated that 450 lbs. of grape seeds yields about 50 lbs. of oil.

Grape-seed and castor oils belong to the vegetable oils, a class that includes the cassia and eucalyptus. They are quite distinct from mineral oils, certain of which also are used as lubricants for machinery. Mineral oils are derived from oil shales and petroleum wells, and are a comparatively recent discovery. As lubricants they are capable of withstanding very high temperatures.

Running a Miniature Railway

How to Get More Fun out of Your Train System

LAST month we dealt with miniature railways in general and discussed the relative advantages of large and small radius rails. We must now consider the subject in more detail. At present we shall deal exclusively with the clockwork trains of the Hornby series and may take this opportunity of referring to certain matters regarding which we constantly receive letters asking for advice.

Treatment of Clockwork Engines

One of the commonest queries is: "How many turns of the key can I give safely in winding up the motor?" This query occurs so frequently as to convince us that it is a result of sad experience with foreign-made engines fitted with clockwork mechanism of very doubtful quality. The clockwork motors of the Hornby engines are very stoutly built and there is little danger of damaging them by overwinding.

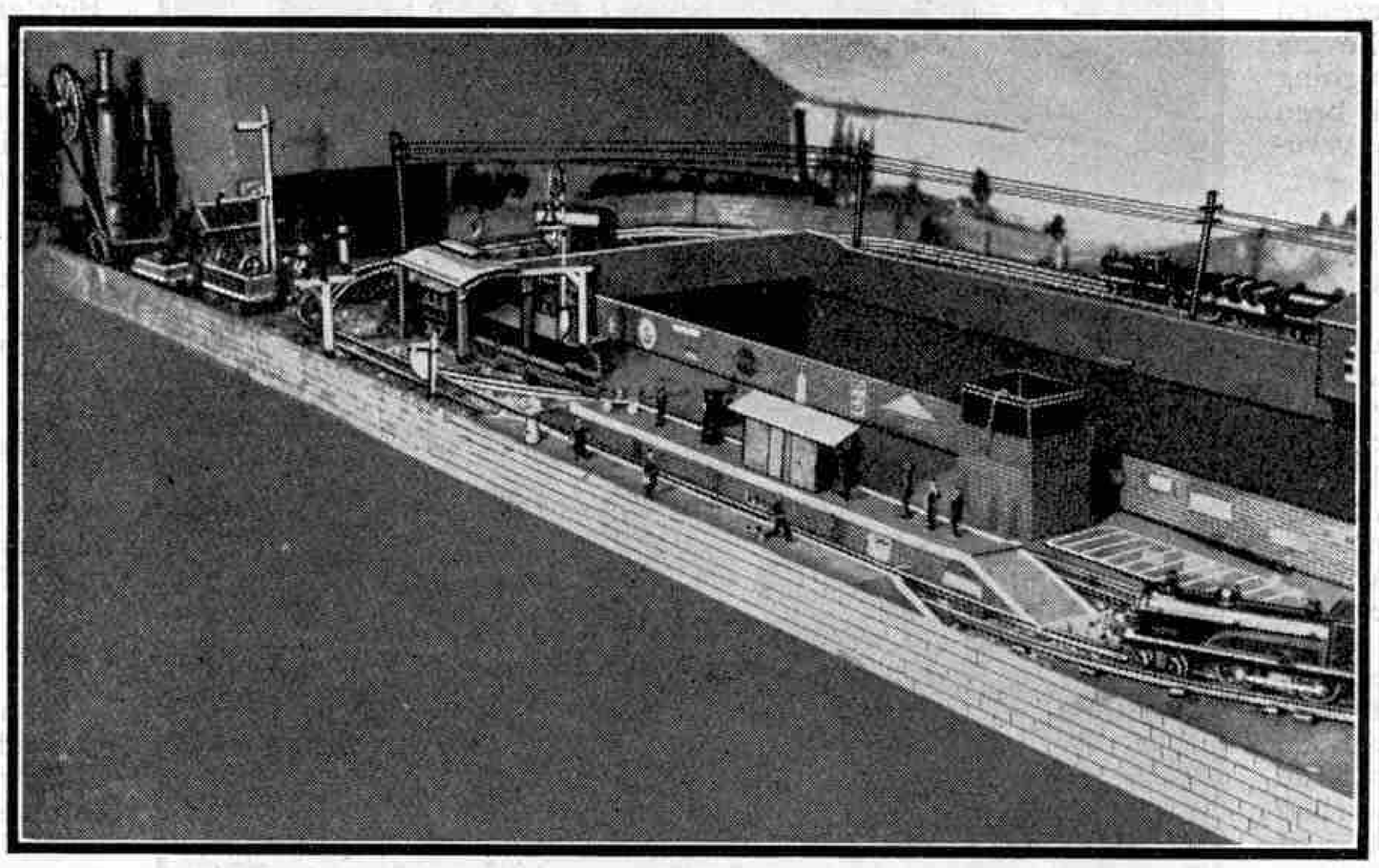
In dealing with a new engine it is a good plan to turn the key gently but steadily as far as it will go *without the slightest forcing*, at the same time counting the number of turns. This experiment will indicate the number of turns necessary to wind up the motor practically to the full. It is unwise to wind any motor to the full as a regular practice, however, and by giving the key say, two turns less than the maximum we have just determined by trial, we shall be on the safe side.

It cannot be emphasised too strongly that a clockwork engine is not at its best when brand new; in fact an engine that has been run for two or three months and treated carefully and intelligently will run appreciably better than a new one.

Importance of Lubrication

Lubrication should never be neglected. For this purpose a very light oil should be used, such as sewing machine or typewriter oil. A thicker oil is almost certain to clog the mechanism. If too thick an oil has been used, or if the engine is clogged with old oil and dust, the best method is to wash the mechanism clean with petrol, subsequently re-oiling. In passing it may be remarked that oil should not be allowed to find its way on to the track.

It is important to remember that the winding key should never be turned backward, for carelessness in this respect may result in a broken spring. Also, the key should be pressed well home as far as it will go on the winding shaft. Other points to bear in mind are that an engine should not be put away after use with the spring wound up, and that when the spring is run down the engine should not be pushed along the track by hand.



A Bradford Reader's Miniature Railway Layout

Our remarks in last month's article concerning permanent layouts have aroused widespread interest. Our correspondence indicates that we underestimated the number of Hornby enthusiasts who possess or contemplate establishing a permanent or semi-permanent layout and we have received quite a deluge of enquiries for more details. The subject is a very wide one, and probably the best method of dealing with it will be to describe one or two layouts that are actually in being.

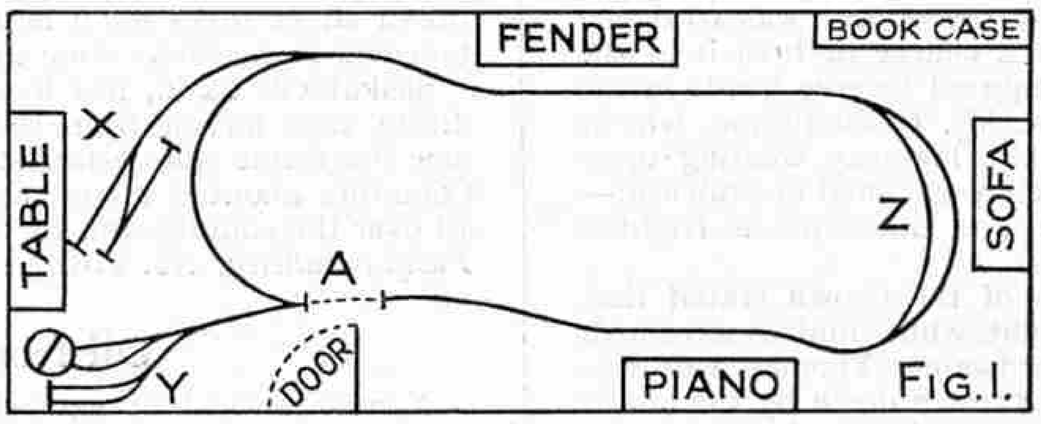


FIG. 1.

A Semi-permanent Layout

First of all, as an example of a semi-permanent layout, let us take the model railway of Mr. W. S. Warnes of Manchester. In this instance it was impossible to devote a room exclusively to the railway, and yet Mr. Warnes was not content merely to lay his track piece by piece on the floor and take it up again piece by piece at short intervals. The household authorities demanded that the layout should be completely removed for cleaning purposes once per fortnight, and that the room should be available for use at any time. The following is the scheme that was adopted to meet these requirements.

The track is laid in sections on planks of wood about 4 ft. in length, and consists of Hornby rails fixed to the wood by means of two screws per length of rail. In consequence the whole railway is rapidly dismantled

into component pieces of convenient size, which are easily stored. Fig. 1 is a plan of the room and it will be observed that the line follows the wall so far as is practicable. Section A is removed when the line is not in use, so that entry and exit are not interfered with.

This layout was adopted because—(1) It gives a terminus to terminus run; (2) It gives a continuous run when desired; (3) Both terminals are near together and therefore if necessary the line can be managed by one operator.

Station Details

A No. 0 Hornby engine, tank or ordinary, will haul a long train from station X, round the continuous run twice and into station Y, being then completely run out. A similar engine then works the train back to station X.

"Peter Pan," the Atlantic loco of the Treasure Island Railway at Wembley

A plan of station Y is given in Fig. 2. The abbreviations are as follows:—E.S., Engine Sidings; T.T., Turntable; M.P., Main Line Platform; L.P., Local Platform; G.S., Goods Sidings.

This station plan, while not in any respect complicated, allows of the carrying-out of a number of interesting and railway-like operations. Among other points it will be observed that an arriving engine can be turned round and, if necessary, run round its train so as to be ready to take it back to station X.

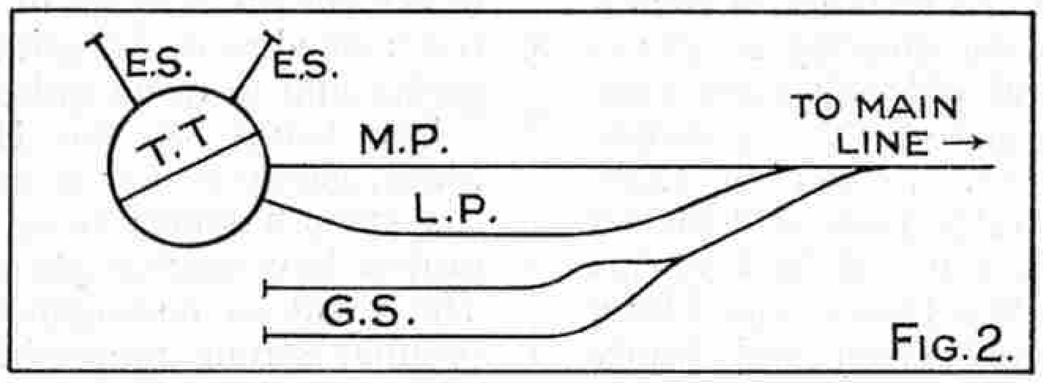


FIG. 2.

Fig. 3 is a plan of station X, the abbreviations being:—C.O., Hornby Crossover; L.P., Local Platform; E.S., Engine Siding.

Station X is a simple country station provided with a passing loop.

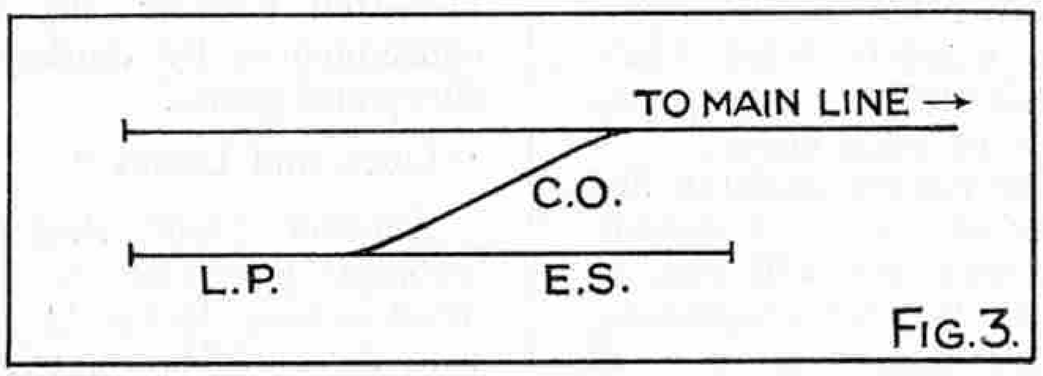


FIG. 3.

Mr. Warnes is a strong believer in developing a model railway on systematic lines; that is to say working to a pre-arranged plan and not just adding bits here and there in haphazard fashion and with no definite end in view. We strongly endorse the following advice contained in a letter from Mr. Warnes to us regarding his railway:—

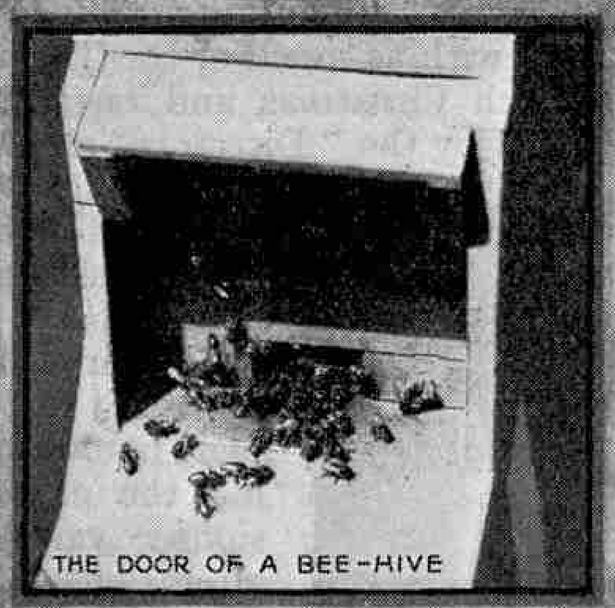
"It is a good policy to work out an "ideal system" to suit the room available, deciding everything to the last detail and then going ahead with as much of the line as funds will allow. Then each Christmas and birthday should be taken advantage of by the "Directors" of the railway to extend their operations and so approach a little nearer the desired complete line. During the extensions various alterations will, of course, be found desirable from time to time. With a little careful management a model railway operated on these lines will become a source of interest to all the family.

A Bradford Reader's Railway

The photograph on the previous page illustrates a permanent model railway constructed by Mr. A. L. Schofield of Bradford. In this case a room is devoted to the layout and the track is laid on boards resting on trestles 3 ft. 6 in. in height. The total length of the Hornby track is about 70 ft. and the rolling stock consists of 17 trucks and coaches, mostly of Hornby manufacture. This layout was completed before the introduction of the Hornby Control System, and the points and signals are worked from a 23-lever signal-box with interlocking fittings. The signals and many of the small buildings such as flagman's hut, platelayer's hut and coal office, are home-made. The photograph conveys an excellent impression of the effective appearance of the railway, the construction of which occupied over a year of Mr. Schofield's spare time.

The railway is run by a Hornby No. 2 clockwork engine which, it is interesting to learn, is assisted by a small steam 0–4–0 engine. The latter runs for about 15 minutes with one filling and is used for shunting purposes. The Hornby loco gives excellent results and is capable of hauling 10 heavy coaches.

The small vertical engine shown on the left of the layout provides power for generating current for lighting the station and other purposes.


THE DOOR OF A BEE-HIVE

The OUTDOOR WORLD

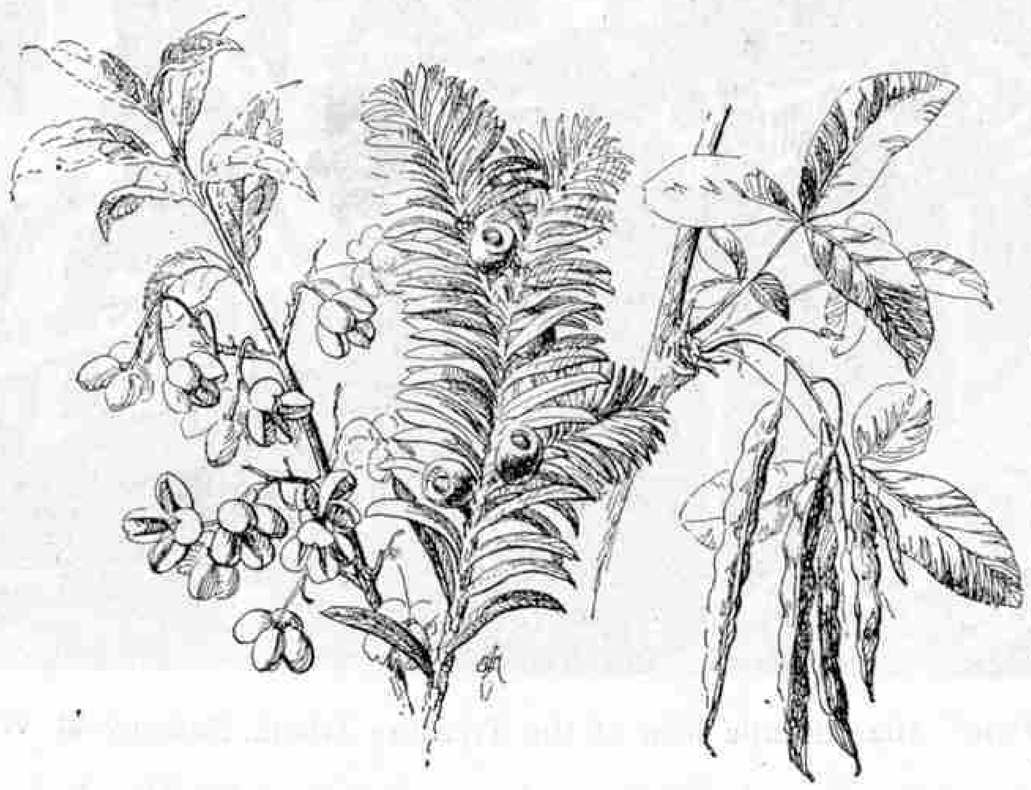
AND ITS HIDDEN BEAUTIES

1.—THE POISONOUS PLANTS OF OUR HEDGEROWS:

By Eric J. Helsby

FROM very early times it has been recognised that certain plants possessed healing virtues while others had poisonous characteristics of a more or less deadly nature. It is easy to understand how plants and trees possessing these special qualities became objects of respect and veneration, and it is very possible that from this source sprang the widespread tree worship of the ancients.

Even to this day legends cling round certain trees and probably it will be many years before they become completely forgotten. One widespread belief of former days was that, by some specified act carried out in a certain manner, a person suffering from a disease could cast his ailment from him into a tree.


Spindle, Yew, Laburnum

Even this country can boast of one instance of such a belief. In bygone days there were growing at Berkhampton in Hertfordshire, several old oak trees that had a great reputation for curing ague by a very simple process. The sufferer was escorted to one of these venerable trees and placed against it. A lock of his hair was then grasped by a second person and firmly pegged into the tree. Summoning up sufficient courage, the sufferer then wrenched himself violently free, leaving behind the lock of hair and, so it was fondly believed, the ague! One wonders what these trees looked like after many years of such cures!

Woody Nightshade

The remote country districts of certain European countries are still rich in ancient beliefs of this nature. In Bohemia it is still possible to be told that an excellent and certain cure for fever is to arm oneself with a hammer and a wedge, proceed to some tree and drive home into it the wedge, solemnly repeating to oneself meanwhile: "There, I knock you in that you may no more come out to me!"

Generally speaking, however, these interesting old superstitions have died out.

In this article we shall describe some of the more common plants that grow in our hedgerows and woods and which, in spite of their beauty, possess poisonous qualities.

The Tall Hemlock

The tall Hemlock reminds us of the tragic part it once played in Greek history. Socrates, one of the greatest of all the philosophers of Greece, was one day arrested and charged with impiety and with unlawfully attempting to reform the religion of the people. He was tried and condemned to death and the sentence was carried out by giving him to drink poison prepared from the Hemlock.

The leaves of the Hemlock are green, glossy and of a neat cut, and the smooth stems from which they project have curious purple markings. The plant is distinguishable by its peculiar strong mouse-like odour. It is an interesting and peculiar fact that though Hemlock is deadly not only to man but also to horses, dogs, rabbits and many other animals, it can be eaten without any ill consequences by donkeys, sheep and goats!

Deadly Nightshade

"Lords and Ladies"

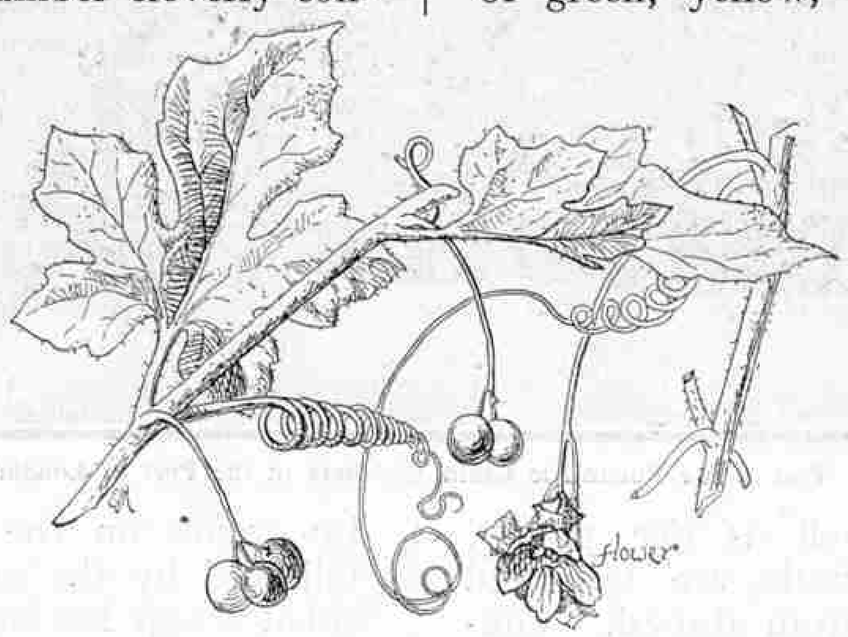
Another plant that is strongly poisonous is the Wild Arum. In the bleak, cold days of March, when the countryside and the woodlands are still a picture of desolation and the wind whistles eerily through the

gaunt, leafless trees, the discerning rambler through the woods will discover here and there the queer little shoots of this plant showing through and above the ground litter of decayed bracken and leaves. Each optimistic shoot comprises the leaves of a new plant so carefully rolled together that they resemble a tiny cylindrical rod. When quite clear of the bracken the leafy cylinder bursts through the top of its protecting envelope. A little further upward growth to clear the envelope, and one by one the leaves gradually uncurl.

Ivy and Wild Arum

The flower of "Lords and Ladies," as the Wild Arum is popularly called, appears in May, and is unique among British flowers. It appears after the manner of the leaves and unfurls as a sort of pale green sheath, often margined with a hint of purple. This lovely sheath, which is one of the plant's most striking features, partially enfolds a purple or red club-shaped object called the "spadix."

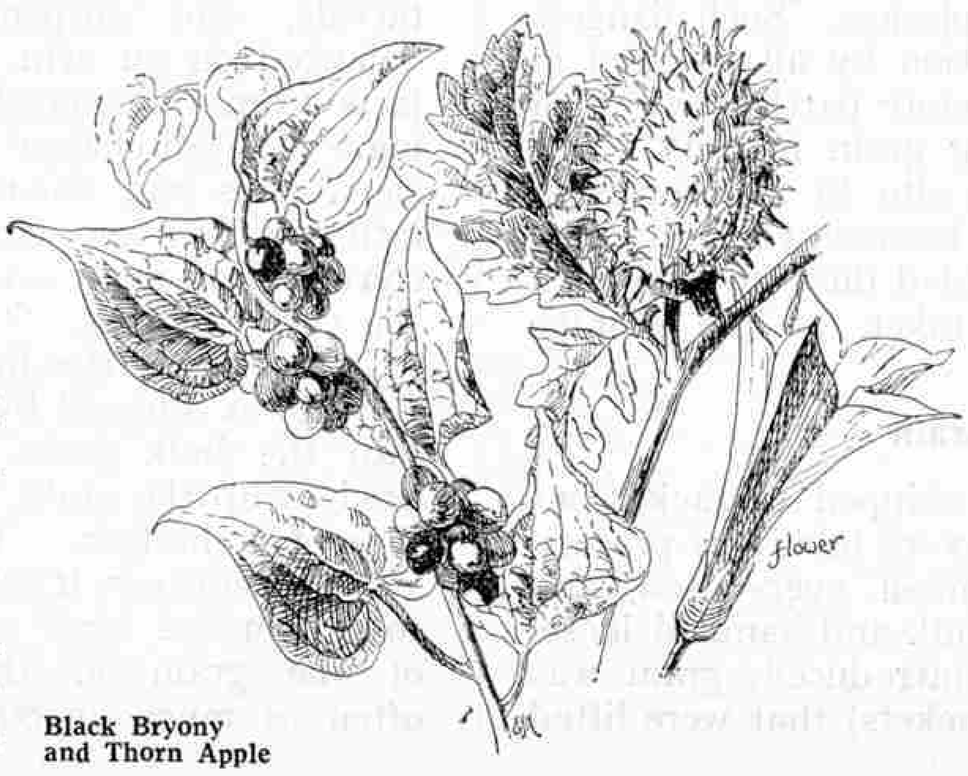
At the base of the spadix is a chamber cleverly constructed of the bottom portion of the sheath and containing two superimposed groups of tiny knobs. Each knob is, in essence, an undeveloped flower, the upper group being males and the lower group females, so that one Wild Arum is really a considerable number of flowers. This mysterious chamber is visited by a variety of pollen-bearing insects, all of whom are cleverly entrapped therein by the flower until their cargo of pollen has been shed on to the female flower knobs.



White Bryony

Meanwhile the male flower knobs gradually ripen and ultimately break up, shedding their pollen in turn on to the captive insects below. The ring of downward sloping hairs at the base of the spadix, providing a kind of verandah to the male and female flowers, now withers and shrivels up. The pollen-bearing insects that so cheerfully slid down into unexpected captivity are now able to escape and to carry their new load of pollen to another flower.

Although the male flower knobs have disbanded, the females do not follow suit. On the contrary, by about the close of June, when the pale green sheath and the spadix have both withered away, the female flower knobs come into prominence. They can then be seen as a bunch of sturdy berries, clustered around what was once the lower half of the stalk. Ripening steadily throughout the long sunny days of July, they slowly change from green to yellow, yellow to orange, and from orange to the familiar bright red. The spikes of thickly set vermilion berries must be handled carefully, for the fruit requires very little agitation for it to fall off. While a forbidden fruit to man, the attractive-looking berries represent many royal feasts to eager birds.



Black Bryony and Thorn Apple

Woody Nightshade or "Bittersweet"

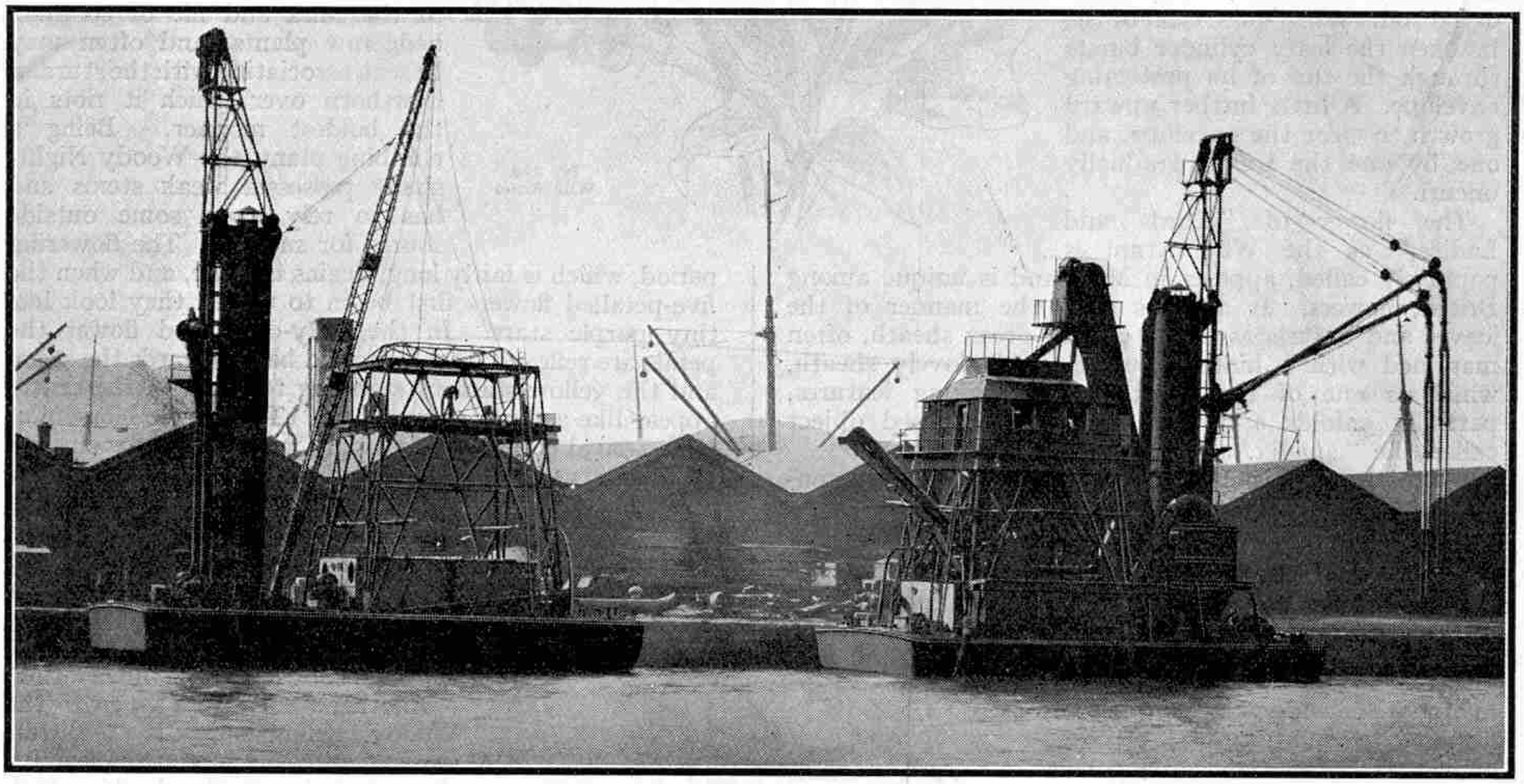
The Woody Nightshade belongs to the rank and file of common hedgerow plants, and often may be seen associating with the sturdier hawthorn over which it riots in the boldest manner. Being a climbing plant, the Woody Nightshade possesses weak stems and has to rely upon some outside source for support. The flowering period, which is fairly long, begins in June, and when the five-petalled flowers first begin to unfold they look like tiny purple stars. In the fully-developed flower the petals are reflexed, that is turned back towards the stem, and the yellow stamens standing together in the centre appear like a small golden cone. The purple blossom of later arrival contrasts pleasingly with the pretty clusters of green, yellow, orange and crimson berries in the various stages from immature to ripe fruit. The berries have been proved poisonous to a certain extent to children. A distinctive feature of the plant is the two miniature leaves at the base of each normal leaf, as shown in the illustration.

Another name often given to the Woody Nightshade is "Bittersweet" and this has arisen from a characteristic of the bark, which at first tastes bitter but later has an agreeably sweet flavour. In this country the shoots of the Woody Nightshade are gathered, dried and used beneficially for certain skin troubles, and also as a remedy for rheumatism.

The Black (or Garden) Nightshade is a non-climbing relative of the Bittersweet. It is an herbaceous plant to be found alike on cultivated land or waste areas, and is more strongly poisonous than the Woody Nightshade. The flowers are similar to those of the latter, but have white petals, and the berries that form in due course are round and black. The poisonous element is probably the most formidable and effective means of protection from violence and depredation that a plant can possess, and it is worth noting that, in the majority of cases, the poison is present only in those portions of the plant that otherwise would be undefended, such as the leaves, flowers and fruit. To some plants additional protection is afforded by the emission of an unpleasant odour, as in the case of the Hemlock leaves already mentioned; or by a prickly surface such as that of the Thorn Apple, one of the poisonous plants that we shall describe next month.

Floating Pneumatic Grain Elev

Unloading Grain by Impr



Two of the Pneumatic Grain Elevators in the Port of London

LARGE quantities of grain, as well as rice, paddy, pulse and seeds of various kinds, are imported into this country every year from abroad. Concerning the loading and unloading of this grain special precautions have to be taken, which are laid down in regulations under the Merchant Shipping Act. Not only do these precautions relate to the shipping of the cargo, but also to the risk of explosion, when stored.

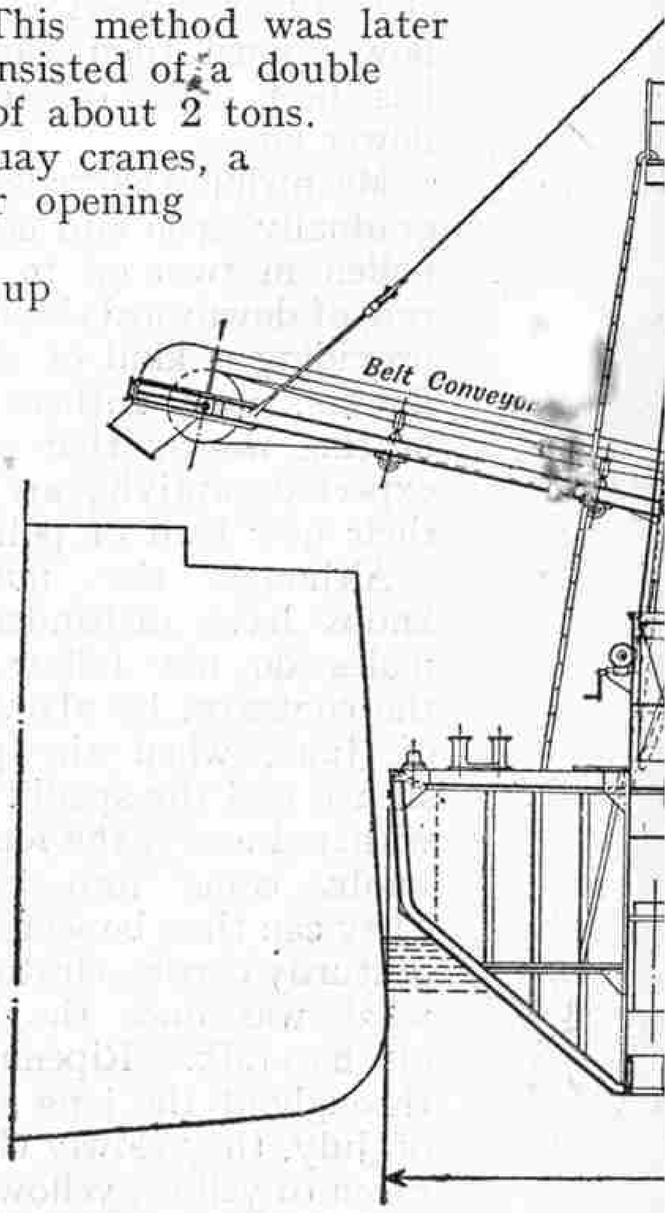
The grain has to be stored in special hoppers, as otherwise it would heat up and ferment, and this would, of course, spoil it. When finely disintegrated particles of carbon or hydro-carbons are present in a confined space and in suspension in dry air, the conditions are very favourable for a violent explosion. Such dangers have to be taken into consideration by all engaged in handling and storing grain, and more particularly so in the modern method of handling grain in bulk. The grain in being moved from one site to another is in constant motion, and the friction between the individual grains gives rise to minutely divided dust, to deal with which special precautions are taken at the storage warehouses.

Previous Methods of Handling Grain

In years gone by, grain was shipped in sacks, but handling grain in this way was a very laborious process. In these days sacks are seldom—if ever—used, and most of the grain is treated in bulk and handled loose. When bulk handling was first introduced, grain was unloaded by shovel and skips (buckets) that were lifted by cranes on the quayside. This method was later followed by the grab, which consisted of a double sided scoop having a capacity of about 2 tons. This also was handled by the quay cranes, a special gear being provided for opening and closing the grab.

In order to further speed up the handling of grain special elevators were next introduced and are still in use. These elevators consist of a continuous belt, arranged vertically and provided with buckets at intervals, and suspended and balanced on an arm that projects from the quayside building. The discharge from the elevator is run down a chute into the building, where it is conveyed by band conveyors to the various stores.

In operation the foot of the elevator is lowered by the arm into the bulk grain, when it dredges up the grain, as in the case of a dredger. With this system, however, it is necessary to "trim" a large proportion of the grain in the ship—often as much as 80%. This

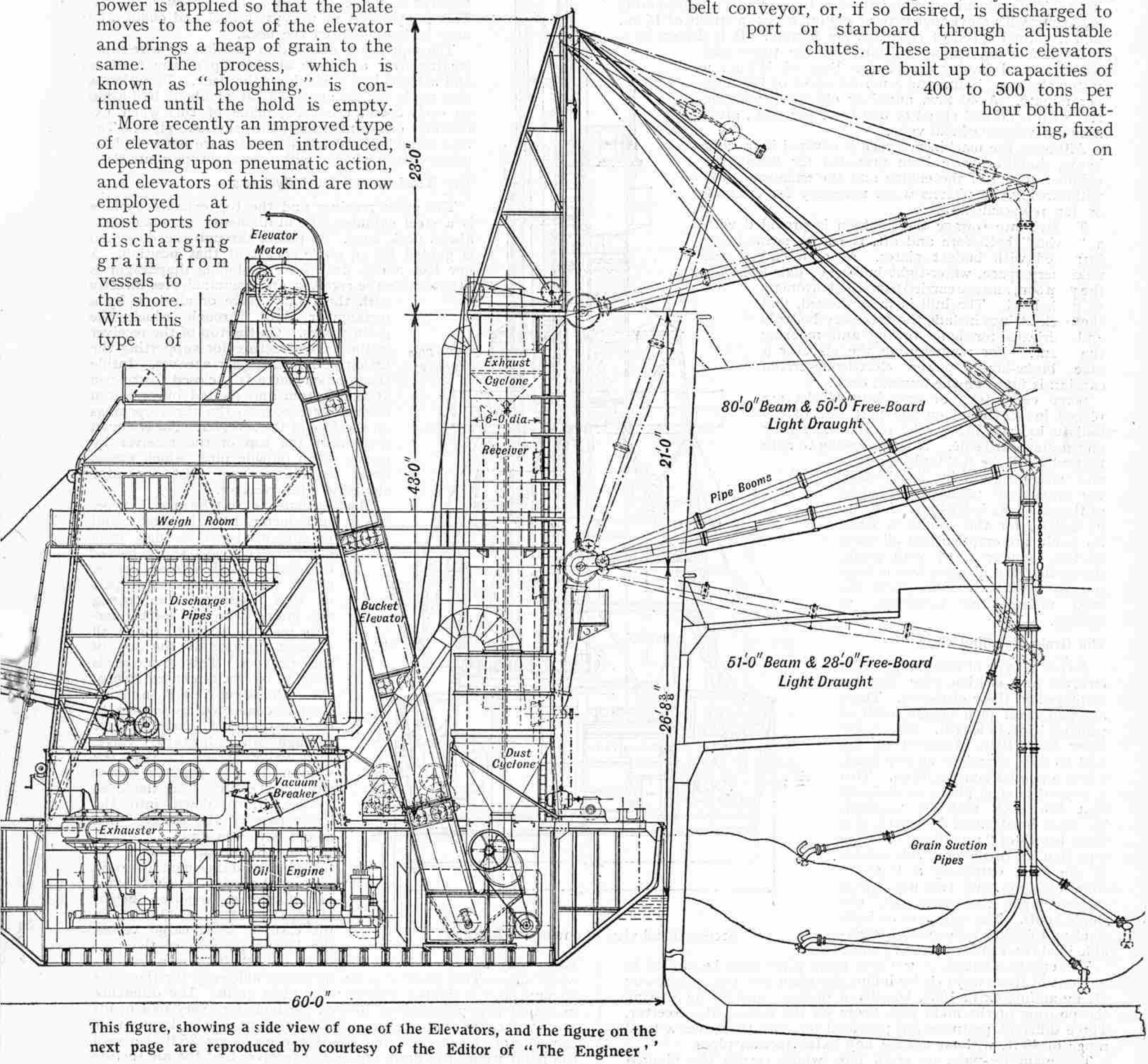


evators at the Port of London

nproved Modern Methods

is done by skilled men who handle a large plate having an area of about 12 ft. × 4 ft. The plate is taken as far from the foot of the elevator as possible and plunged into the grain. Haulage wires are provided, and to these power is applied so that the plate moves to the foot of the elevator and brings a heap of grain to the same. The process, which is known as "ploughing," is continued until the hold is empty.

More recently an improved type of elevator has been introduced, depending upon pneumatic action, and elevators of this kind are now employed at most ports for discharging grain from vessels to the shore. With this type of elevator long flexible pipes are lowered into the ship's hold, and the grain to be discharged is sucked up and delivered by a bucket elevator to the weighing-room. Here it is weighed and discharged aft by means of a belt conveyor, or, if so desired, is discharged to port or starboard through adjustable chutes. These pneumatic elevators are built up to capacities of 400 to 500 tons per hour both floating, fixed on



This figure, showing a side view of one of the Elevators, and the figure on the next page are reproduced by courtesy of the Editor of "The Engineer"

quayside, or portable on rails.

In this article we are able to describe two new grain elevators of the floating pneumatic type, that have been built to the order of the Port of London Authority. The vessels, which are named the "*Legion*" and the "*Phalanx*," are identical in design, and their machinery embodies several new features marking a distinct departure from the earlier types of elevators.

General Features of Elevators

The elevating machinery is mounted on a pontoon somewhat similar in design to the pontoons upon which block-setting cranes are mounted. The following table gives the leading hull dimensions of these pontoons :—

Length between perpendiculars	60 ft.
Breadth moulded	31 ft.
Breadth at bottom of pontoon	28 ft.
Depth moulded	11 ft. 6 in.
Draught	6 ft. 10 in.

The average output of these grain elevators is 110 tons per hour. Their machinery consists of a two-cylinder double-acting exhauster with a cylinder bore of 40¼ in., a piston stroke of 15 in., and a normal speed of 188 revs. per minute. It is driven by a four-cylinder oil engine working on the two-stroke principle and having a cylinder bore of 15½ in., a piston stroke of 19 in., and a normal speed of 188 revs. per minute. A 40 k.w. auxiliary electric generating set, with a normal speed of 300 revs. per min., gives a circuit voltage of 220 volts.

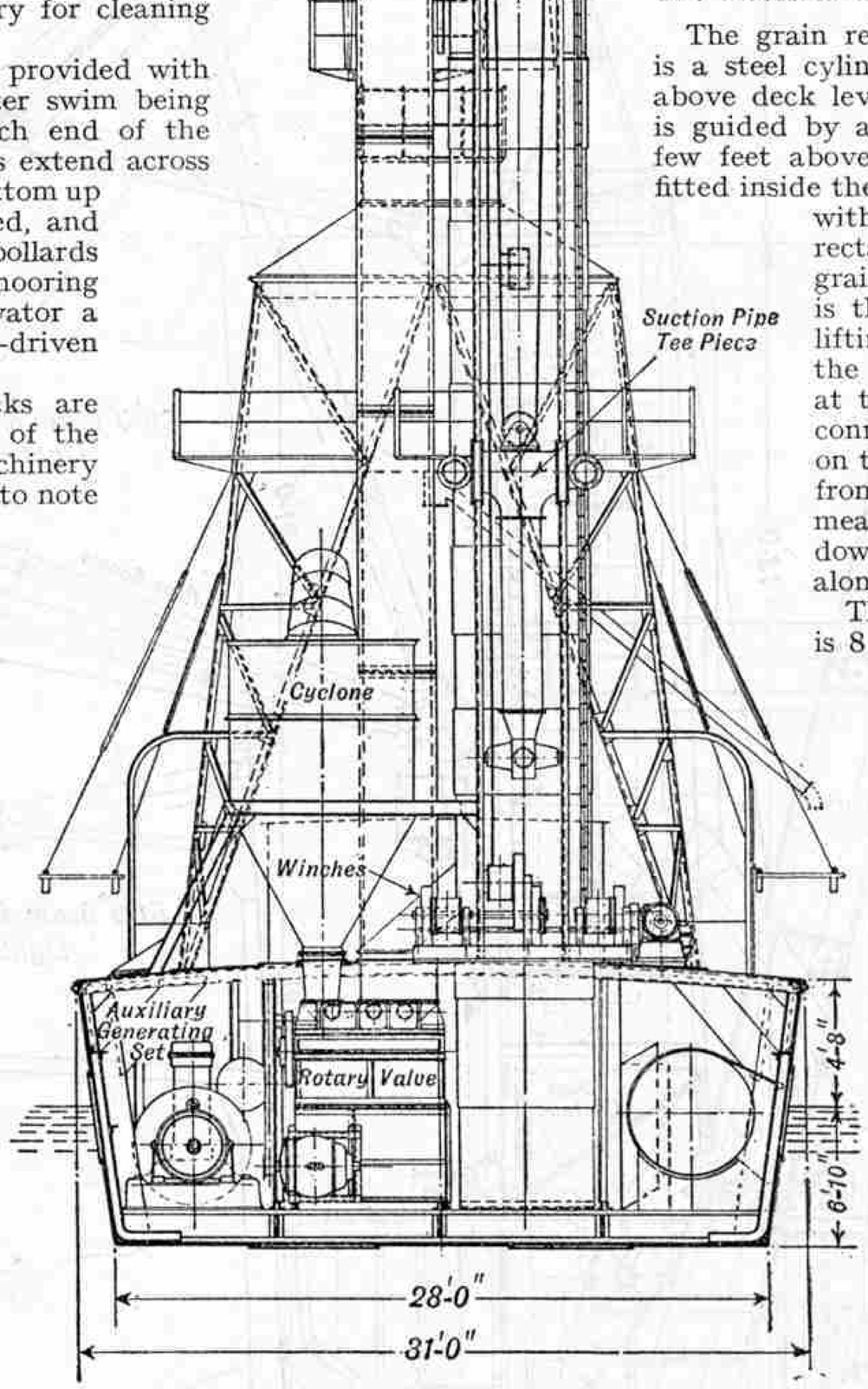
Although the machinery space is covered by a deck house, facilities have been provided for lifting the cylinder covers of the engine and the exhauster, and withdrawing the pistons when necessary for cleaning or for replacements

To facilitate towage the pontoon is provided with a "swim," both fore and aft, the after swim being furnished with budget plates. At each end of the machinery space, water-tight bulkheads extend across the pontoon, and are carried from the bottom up to deck level. The hull is flush decked, and the deck fittings include the necessary bollards and fairleads for both towing and mooring the plant. For manœuvring the elevator a nine brake-horse power electrically-driven capstan is fitted on the forward deck.

Some eight tons of cast iron blocks are placed in the bilges on the port side of the hull to balance the weight of the machinery on the starboard side. It is interesting to note that when all the fuel tanks are filled and with no grain in the elevator, the transverse metacentric height of the structure is 3,843 ft. A figure of 2.43 ft. for the condition when the tanks are emptied and all parts of the elevator filled with grain, shows that the elevator has a large reserve of stability even under the most unfavourable conditions of loading.

The Grain-Handling Gear

A special type of new design grain receiver and suction pipe jibs are employed in these elevators. There are two main pipe booms, each of which is 35 ft. in length. The booms taper from 10 in. diameter at the heel to 9 in. diameter at the head, where a special bend is fitted. This is formed of steel plates so designed that the back may be renewed. To each head there is attached a short length of "armadillo" flexible pipe 9 in. in diameter. This carries at the lower extremity a Y piece, from which depend two 6 in. grain suction pipes that pass into the ship's holds. The pipes are of both rigid and flexible types with detachable joints and suction mouth-pieces.



Sectional end view of one of the Elevators

The effective length of the four grain pipes may be altered in any one of three ways (1) by luffing the main boom up and down ; (2) by adding extra 10 ft. lengths of piping ; and (3) by altering the position of the main pipe boom on the face of the receiver. Three different positions are provided for, and this gives a total range of 40 ft. without adding any extra suction pipes.

The main tee-piece or grain box, which carries the pivoted heels of the twin pipe booms, is made of cast iron and is suspended by wire ropes. Passing over sheaves at the top of the receiver, these ropes are attached to winches on the deck below. The tee-piece is free to move up and down the receiver, and travels on rollers that engage with runner bars built on to the receiver face.

Beneath the tee-piece there is a tubular extension piece, terminating on a rectangular opening with a rubber-jointed facing. On the face of the receiver are three corresponding openings to any of which the tee-piece connection may be jointed. The first of these openings is about 9 ft. 6 in. above deck level. Ten feet higher is the second opening, shown in use in the illustration reproduced on page 240, while 10 ft. higher still is the top opening, which is only employed for ships of high freeboard. Openings that are not required are closed with rubber-faced doors by toggle gear.

The joint between the tee-piece extension and the receiver is made by means of a screw jack bar. This is operated by a gypsy wheel and chain, and may be worked from the deck.

The pipe heads are held in position by wire ropes passing over a sheave at the top of the receiver and attached to a winch on the deck. Provision is also made for an auxiliary lift of about half-a-ton on each boom, use being made of this when extending or dismantling the suction pipes. The pipe handling and auxiliary lifts are controlled by motor-driven winches with tramway type controllers.

The Receiver and Dust Cyclones

The grain receiver and the top exhaust cyclone is a steel cylinder 6 ft. in diameter, standing 43 ft. above deck level. It passes through the deck and is guided by an angle socket at that position. A few feet above deck level a sloping diaphragm is fitted inside the receiver, and communicates directly with the rotary valve or air lock by a rectangular duct through which the grain passes. On the top of the receiver is the superstructure for supporting the lifting and luffing gear sheaves. Inside the receiver there is a closed duct open at the bottom and jointed by cast iron connecting pieces to the three openings on the face of the receiver. Air is drawn from near the top of the receiver by means of an outside pipe, which passes down to the cyclone dust separator alongside the receiver.

This cyclone is of the usual type, is 8 ft. in diameter, 13 ft. in height, and is supported on a high steel gantry. The cyclone discharges the dust through a rotary valve, which valve forms a third part of that used for discharging the grain. At this point reference may be made to the small exhaust cyclone at the top of the receiver. This cyclone is coupled to the discharge side of the exhausting pump, and its cone is connected by a pipe to the bottom of the main receiver through an adjustable valve. This valve is set so that the vacuum in the receiver causes any dust collected in the cone to be drawn down into the lower part of the receiver and mixed with the grain.

The advantage claimed for the above arrangement of grain pipes and receiver is that, while the maximum required height of pipes—40 ft.—is obtained, in the case of small cargo vessels the lowest position of the pipe boom may be selected at a height of only 26 ft. 8 in. above the water line. This position gives increased efficiency for the same vacuum and a smaller amount of broken grain. The difference in output is approximately 10 cwt. per hour for every foot of lift on the face of the receiver. Another point is the large cubic capacity of the receiver and the distance of over 25 ft. between the point where the grain enters the receiver and the air suction

connection. This distance gives less turbulence, and the tendency for grain dust to be caught up and entrained in the induction pipe is avoided. Glass windows are fitted at various points on the receiver to permit of interior inspection when the plant is working.

The Rotary Valve and Bucket Conveyor

In the machinery room alongside the receiver and beneath the dust cyclone is the rotary valve or air lock. It is designed for a maximum output of 300 tons of grain per hour, the extra capacity allowing for gluts of grain or such obstacles as pieces of timber that may pass through the valve. In case of obstruction, the valve is reversed electrically as soon as the motor driving it is overlooked. To avoid shock when reversing a raw hide belt drive is used from the 5 h.p. motor to the valve.

The valve works well, the average power taken on maximum load being 3.33 b.h.p., and the greatest power taken a little over 4 h.p. The reversing gear has very rarely been used.

The air lock discharges the grain directly into the boot of a bucket elevator designed for a maximum capacity of 180 tons per hour. It is driven by a 15 b.h.p. motor mounted on the elevator hood, cast iron gearing enclosed in a steel casing being employed. The elevator is fitted with roller bearings and has two steel chains. Inspection doors give access to the working parts. On the top of the elevator platform is a small davit which can be used to handle and lower any part of the machinery should occasion for its use arise.

The Weigh Room and Discharging Apparatus

As shown in the diagram on page 241, the weigh room is mounted on a latticed steel structure erected over the machinery space. In the centre of the room are eight Avery 250 lb. automatic dust-tight scales supported on steel bearers. Above the scales is the feeding hopper, which forms part of the roof and has a capacity of 6 tons. It is connected to the scales by eight chutes, each fitted with a control sluice valve.

The grain is fed into the hopper bythe bucket elevator already mentioned, and is again discharged from the scales through eight three-way valves constructed of steel plate. The valves are operated from the deck, and by means of them the weighed grain may be discharged either to port or starboard on to a central hopper that feeds the belt conveyor arranged aft.

The conveyor, which is pivoted and may be drawn up clear of all dock craft when it is not required, is driven by a 5 h.p. motor through enclosed gearing. It has a designed output of 150 tons per hour and the belt itself is covered with a canvas hood to protect it from the weather. Extension chutes are provided for discharging the grain both to port and to starboard, when filling lighters with bulk grain.

When sacking the grain the work is carried out on timber platforms, elbows being fitted to the chutes so that the filling of the sacks takes place at a convenient height for handling. The discharging apparatus is so designed that the weighed grain can be discharged simultaneously in known quantities on both sides of the vessel and also aft.

The ship is lighted throughout by electricity and large "bunch lights" are fixed to each pipe boom on the superstructure and also at each side of the weigh room to facilitate work at night.

The Machinery Equipment

The main exhausting machinery is a double-acting two-cylinder exhauster, driven direct from a four-cylinder oil engine. Both are mounted on a common bed-plate fixed in the centre of the engine-room. The engine is rated for an output of 230 b.h.p. at a speed of 188 revs. per minute, and its four cylinders are 15½ in. in diameter and have a stroke of 19 in. The engine exhaust passes into a large silencer at the back of the engine from whence it is discharged through water-cooled exhaust pipes to the main exhaust uptake.

The fuel pumps, governor and control levers are placed at the end of the engine bed-plate, where is also oil pump that supplies forced lubrication to all bearings.

The cylinders of the air exhauster are water-cooled, and are each furnished with forty-eight spring-loaded disc valves of large diameter and relief valves are fitted on the discharge branches of the exhauster. The pistons are of a light box section, machined all over, and are fitted with two cast iron piston rings. A flake graphite lubricator is fixed on the induction pipe for the lubrication of the main cylinders of the exhauster.

The exhausting unit is designed for an overload capacity of 275 b.h.p. and a speed range of 20% above and 30% below normal speed. This enables various qualities of grain and different discharge conditions to be dealt with. Provision is made for changing the speed of the engine while it is running, and at all times the speed is controlled from "no load" to "full load" by the governor.

End on view of Elevator sectioned in diagram on previous page

The plant is capable of maintaining a vacuum of 11 in. of mercury if so desired, but under normal conditions of working only 8 in. to 9 in. vacuum is necessary. A vacuum breaker, consisting of two disc valves which can be controlled by a hand wheel from the engine platform, is provided to facilitate easy starting. The necessary starting air bottles are fitted and the running equipment includes storage and ready-for-use fuel and lubricating oil tanks, vacuum gauges, tachometers, and a self-recording barograph.

The Elevators under Test

The auxiliary machinery includes a main lighting and power-generating set, consisting of a 60 b.h.p. single-cylinder oil engine driving a 40k.w. 220-volt dynamo. This machine is of the protected type, and is constructed for a running speed of 300 revs. per minute. The current generated is utilised for driving the main bucket elevator; port and starboard pipe lifting winches; winch for lifting the tee-pieces; deck capstans; rotary air locks, and the belt conveyor arranged aft. A Reavell starting-air compressor, a bilge pump, a fuel oil pump, and a ventilating fan are also fitted.

By the courtesy of the builders of these elevators (East Ferry Road Engineering Co. Ltd.), and of the Port of London Authority, we are able to give the results of a trial test.

	Average duty.	Maximum duty.
Rate of discharge of grain (tons per hour)	113.1	133
Brake horse-power of air exhauster	201	220
Brake horse-power of air locks ...	3.33	4.1
Brake horse-power of bucket elevator	12.30	14.3
Total brake horse-power for average duty	216.63 b.h.p.	
Average exhauster power, per ton per hour	1.75 b.h.p.	
Average per ton per hour, exhauster and auxiliaries	1.91 b.h.p.	
Fuel oil consumption per ton per hour ...	0.89 lb.	
Lubricating oil consumption per ton per hour	0.069 lb.	

It will probably be of interest to our readers to learn something of the running costs of such machines as these elevators. On the tests, above referred to, the following figures were obtained :—

Cost of fuel oil (at £6 per ton) per ton per hour	0.57 pence
Cost of lubricating oil at 3/9 per gallon, per ton, per hour	0.34 ,,
Cost of running main engine only, per ton per hour	0.91 ,,
Cost of running main engine and auxiliaries, per ton per hour	0.98 ,,
Total cost of discharging grain, per ton ...	1.0 ,,

Since the above test was carried out, a fuel oil of a cheaper grade, bought in bulk at £3/10/- per ton, has been used and the total cost for both fuel and lubricating oil has consequently been reduced to 0.7d. per ton. An average figure for last year was 40/- per day for the cost of fuel and lubricating oil, or approximately 4/9 per 100 tons of grain discharged.

These results show a considerable saving when compared with the outputs and working costs of the steam-driven pneumatic grain elevators that are working in the Port of London. These elevators discharge an average output of grain of from 80 to 90 tons per hour, and use about 5 tons of coal per day, which, at 26/- per ton, amounts to a cost of about 19/- per 100 tons of grain discharged.

Other advantages claimed for the oil engine-driven elevator are the saving on engine-room staff and the quick starting. Only one engineer and two greasers are employed, as against one engineer, one greaser and three firemen in the case of the steam-driven elevators. The plant is ready for service within two minutes of the men coming on board.

Famous Trains—(*continued from page 212*)

been a sky-blue McIntosh or Pickersgill 4–4–0; to-day, as likely as not, we shall find a Midland 3-cylinder 4–4–0 compound backing on. Numbers of these engines are now at work in Scotland, and to the credit of the Scottish drivers be it said that they are getting some of the best work out of them that is seen on any part of the L.M.S. system.

Here, too, the weary postal staff, who have been working without intermission from London throughout to Carlisle, relinquish their charge of the train and give place to a bevy of Scottish sorters, who are going to work the "Postal" forward to Glasgow and Aberdeen.

By this time we ought, by rights, to be weary too, and the probability is that the remainder of the journey will find us too drowsy to take much notice of what is going on. From Carlisle we head northwards into the mountains of the Scottish Lowlands. Leaving at 3.3 a.m., we are allowed only 44 mins. in which to cover the 39¾ miles to Beattock, although much of the distance is uphill at 1 in 200. The stop at Beattock is compulsory, in order that we may attach in rear one of the banking engines kept there perpetually in steam for the purpose of assisting trains up the 10 miles at between 1 in 69 and 1 in 88 up to Summit, which is at no less than 1,015 ft. above the sea.

After passing Beattock Summit all our difficulties are at an end. We enter the valley of the Clyde and follow it all the way down to Glasgow, crossing the river in all some six times. At Carstairs the "Postal" is divided. Arriving there at 4.32 a.m., the Aberdeen portion leaves at 4.36, and then, calling at Stirling and Perth only, reaches the "Granite City" eight minutes before 8 a.m. The rear portion is whisked away, with an engine on the other end, to Edinburgh, and the middle runs on down to Glasgow, coming to rest in the Central Station, 401½ miles from Euston, at 5.25 in the morning, in ample time to allow of the delivery on some Scottish breakfast table of the letter that you posted in London the evening before, after its adventurous journey on the "West Coast Postal."

Leading Dimensions of L.M.S. 4-cylinder 4-6-0 Engines, "Claughton" Type

Cylinders (4), Diameter	16 in.
,, Stroke	26 in.
Driving Wheels, Diameter ...	6 ft. 9 in.
Heating Surface, Fire Tubes ...	1,161 sq. ft.
,, ,, Flue Tubes	486 ,,
,, ,, Firebox	171 ,,
,, ,, Superheater ...	414 ,,
,, ,, Total	2,232 ,,
Firegrate Area	30½ ,,
Working Steam Pressure ...	175 lb. per sq. in.
Tractive Effort (at 85% wkg. press.)	24,445 lb.
Water Capacity of Tender ...	3,000 gallons
Coal ,, ,, ...	6 tons
Adhesion Weight of Engine	59 ,,
Total Weight of Engine (in working order)	77¾ ,,
Total Weight of Engine and Tender (full)	116 ,,
Length of Engine and Tender (over Buffers)	63 ft. 5 in.

OUR MAIL BAG

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

D. Eyres (Wellington, N.Z.)—We got quite excited over your letter telling us of earthquakes and floods. Some people have all the fun! When, however, you went on to suggest that the "*M.M.*" should be increased to 1,000 pages you upset us rather badly. Since then we have not been able to sleep for trying to work out how many articles would be required for each issue, how many illustrations, and how many people we should require to prepare it all!

R. F. Hartnell (Queensland, Australia).—You are quite right, England is a land of glorious scenery, and of fascinating historical interest and we know you must have enjoyed your visit. You have our best wishes for a safe and pleasant voyage home.

K. Stuart (Sheffield).—We cannot quite agree that editors exist *solely* for the purpose of receiving complaints, but we are always glad to receive criticisms, especially in the case of readers who, as you say, feel better after putting forward their little growl! We agree that the stamp articles recently have been on the historical side, but after all, does not a good deal of the fascination of stamp collecting lie in finding out exactly what each stamp means?

F. Kitchen (Netherfield).—We have received hundreds of letters like yours expressing appreciation of the new coloured Meccano. We were particularly interested to hear that the boys in your village thought nothing of Meccano until you let them build a model with your set, and that they immediately afterwards began to worry their fathers to get them each a set for Christmas!

Mr. F. E. King (British Malaya).—It is very cheery to hear that Meccano is establishing itself in your part of the world and that your friends speak so highly of its reliability. We hope that your club to encourage the hobby of model-building will be a success. If you have any difficulty in obtaining Meccano parts please let us know.

F. Arthur (Glasgow).—"I've found great joy with Meccano since Xmas and there's no doubt about it, Meccano is more than a toy." You are quite right, Frank. Even if we had any doubt about this ourselves we should quickly be convinced by the hundreds of letters expressing this opinion that we receive from all over the world.

T. J. Appaduray (Perak, F.M.S.)—Your continued interest in the Guild and in the Correspondence Club is very encouraging. You have rather neglected us lately but we hope you will write oftener in future. This year the "*M.M.*" is going to be not only bigger but better than ever. Many thanks for your good wishes, which we sincerely reciprocate.

C. J. Longland (Tanganyika Territory).—We have always been interested in lions at the Zoo, but lions prowling about at night and eating people are quite another matter! After reading your account we came to the conclusion that England is not such a bad place after all! Your account of the thunderstorms you have had is quite thrilling. Write again soon and tell us more about your interesting country.

E. Rockingham-Shaw (Calcutta).—You appear to have been experiencing a very busy time with an abcess in your ear; riots and bloodshed amongst the Indians; men, animals, and birds dying from the heat and then monsoons bursting on you! We hope that your health is now restored and that **tranquillity** reigns once more in Calcutta. We also trust that you have now secured both a Leader and a room for your Meccano Club.

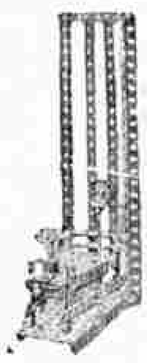
E. Morgan (Gundagai, N.S.W.)—We wish we had space to deal with the many interesting things you have written us about, Ernest—the floods in Gundagai, your Boy Scout adventures, your successful Meccano party, etc. We should like to hear more about your factory and the machines you are making. We wish yourself and your brother long years of Meccano fun.

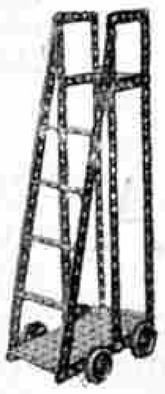
G. A. Geach (Gateshead).—"Why did the Germans have an armistice? Where are the Bugh and Fokker aeroplanes made? How many Handley-Page aeroplanes were ready to bomb Berlin at the end of the war? What is the best mechanical job for a boy now? In the Wee Bee I. is the "I" pronounced "eye" or "one?" Could you tell me how Rotor Ships work?" What do you do with all this information, George? Our Encyclopædic Expert is doing his best for you and will write you separately. Your three letters were welcome and any others will be also.

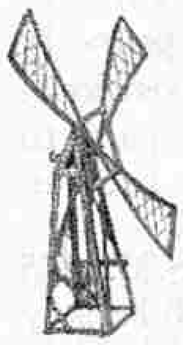
A New "No. 2 Outfit"

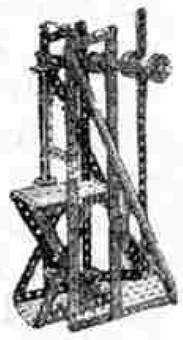
Model-Building Competition

In this competition, which is the third of the new " Outfit " series, we are offering prizes for the best models made entirely from a No. 2 Meccano Outfit. Models comprising parts that do not appear in this Outfit will be disqualified. It is not necessary to use all the parts contained in the Outfit. Those boys who possess larger sets need not abstain from competing, for their entries are eligible providing only those parts which may be found in the No. 2 Outfit are used.









FOUR DIFFERENT SECTIONS

Prizes will be awarded for the models that the judges decide to be the best received, after due consideration has been given to the originality of thought and constructive skill displayed in every entry. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts. Any type of model may be submitted provided that it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following sections :—Section A, for competitors over 16 years of age. Section B, for competitors under 16 and over 12 years of age. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain.

LIST OF PRIZES

Prizes will be awarded for the three best entries FROM EACH SECTION as follows :—

FIRST PRIZE : Meccano products to the value of £3-3s.
SECOND PRIZE : Meccano products to the value of £2-2s.
THIRD PRIZE : Meccano products to the value of £1-1s.
SIX PRIZES, each consisting of Meccano products to the value of 10/6.

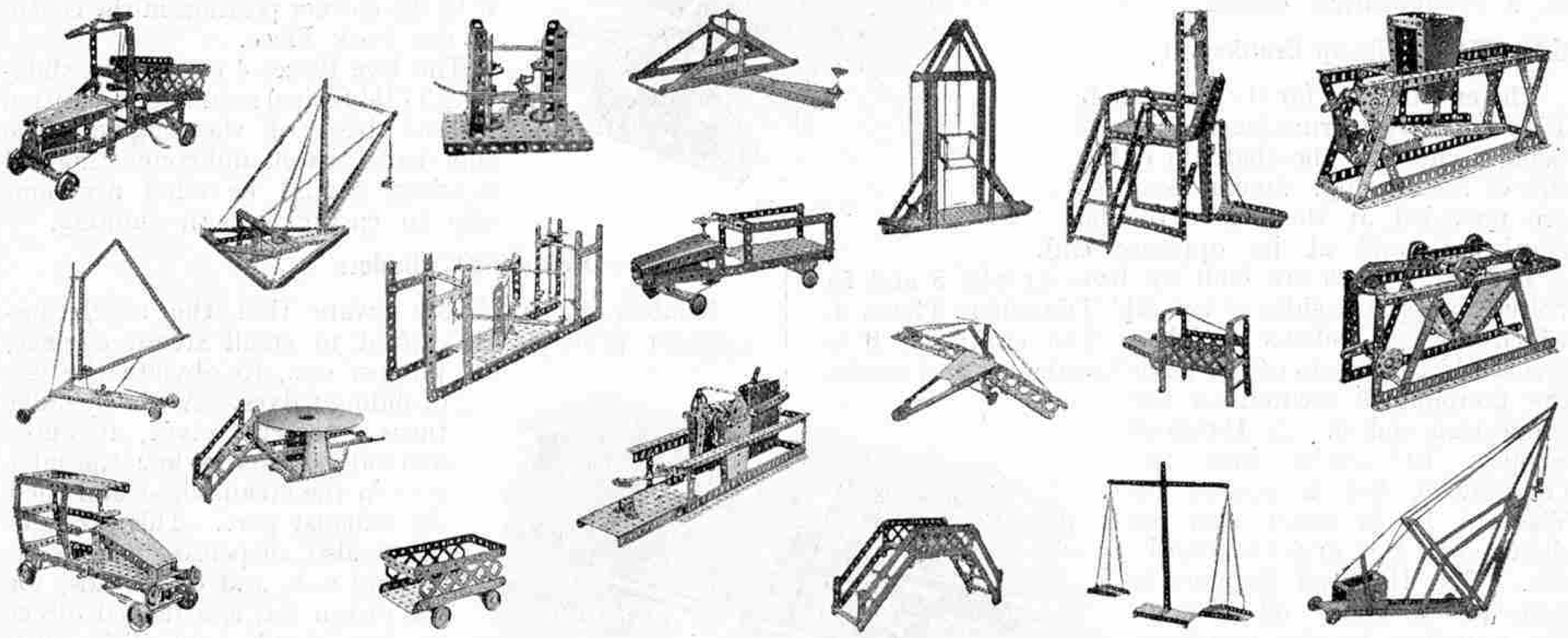
Closing date for Sections A, B, and C : 30th April. Section D : 31st August, 1927.

We append a list of parts contained in the latest No. 2 Outfit, for the reference of competitors.

Contents of No. 2 Meccano Outfit

10	of No.	1	4	of No.	11	2	of No.	18A	1	of No.	34
14	„ „	2	12	„ „	12	1	„ „	19	12	„ „	35
2	„ „	3	2	„ „	12A	4	„ „	20	1	„ „	36
12	„ „	5	2	„ „	15	4	„ „	22	49	„ „	37
2	„ „	6A	1	„ „	15A	2	„ „	22A	6	„ „	37A
4	„ „	8	4	„ „	16	1	„ „	23	12	„ „	38
8	„ „	10	2	„ „	17	1	„ „	24	2	„ „	40
						2	of No.	126A			

1	of No.	44	2	of No.	62			
1	„ „	45	4	„ „	90A			
8	„ „	48A	2	„ „	99			
1	„ „	52	2	„ „	100			
2	„ „	54	6	„ „	111C			
1	„ „	56	1	„ „	115			
1	„ „	57	4	„ „	125			



IMPORTANT INSTRUCTIONS

Readers should send in clear photographs or good drawings of their models, together with any explanations that may be necessary, although the latter should be made as brief as possible.

The following instructions must be followed closely :—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition (No. 2) and the Section in which the model is entered. Envelopes should be addressed " No. 2 " Competition, Meccano Ltd., Binns Road, Liverpool.

Actual models should not be sent. A clear photograph or drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Limited.

MECCANO
STANDARD MECHANISMS

Section XIII. Miscellaneous Appliances—(*continued*)

Below we conclude the series of articles that have appeared under the title of "Meccano Standard Mechanisms." These Meccano movements have been termed "Standard Mechanisms" for the reason that they may be adapted with advantage to numerous Meccano models—in most cases without any alteration, but in some few instances with slight alterations to the standard movement. The whole series now may be obtained in book form (Post free 1/1½d., Overseas 1/7½d.) We recommend those readers who have shown so much interest in the articles to keep a copy of the "Standard Mechanisms" Manual close at hand when model-building, for it forms a reference book that all keen Meccano boys will appreciate.

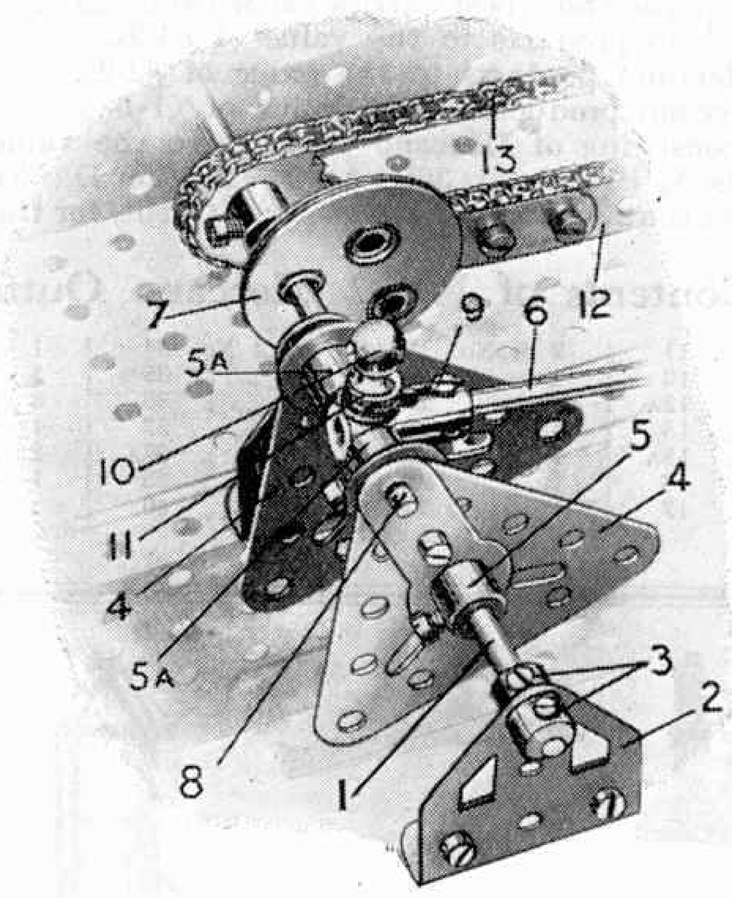
A CRANKSHAFT having a stroke of 1" is included in the Meccano system under part No. 134 (see Suggestion No. 78, page 253 of this issue), but obviously this accessory is not suitable for the larger models of reciprocating engines or similar mechanisms. It would be extremely difficult, even if desirable, to introduce a standardised unit to serve as a crankshaft in all Meccano models that require such a part. On the other hand it is quite a simple matter to build up a crankshaft to any specified design from existing parts. A typical Meccano crankshaft, complete with balanced cranks, eccentric, etc., is shown in S.M. 274, and this detail should serve to indicate the manner in which certain parts can be used to the best advantage in order to construct a strong and smoothly working model of a reciprocating engine.

S.M. 274—Built-up Crankshaft

The end bearing for the crankshaft 1 is formed by a Trunnion 2, Collars 3 being secured to the shaft on either side of the bearing. Similar bearings are provided at the centre of the crankshaft and at its opposite end.

The crank arms are built up from Cranks 5 and 5a bolted to opposite sides of two 2½" Triangular Plates 4, which form a balance weight. The crank-pin 8 is secured in the bosses of the inner Cranks 5a, and carries the Coupling 9 secured to the connecting rod 6. A Handrail Support 10 screws into the Coupling 9, but is spaced by Washers 11 in order that its shank shall not grip the crank-pin. The Handrail Support is removed to admit oil through the Coupling to the crank-pin when lubricating the model.

The Eccentric 7 operates the valve mechanism, its arm being extended by a Strip 12, while the Sprocket Chain 13 rotates the engine governor as can be seen on reference to Standard Mechanism 87.



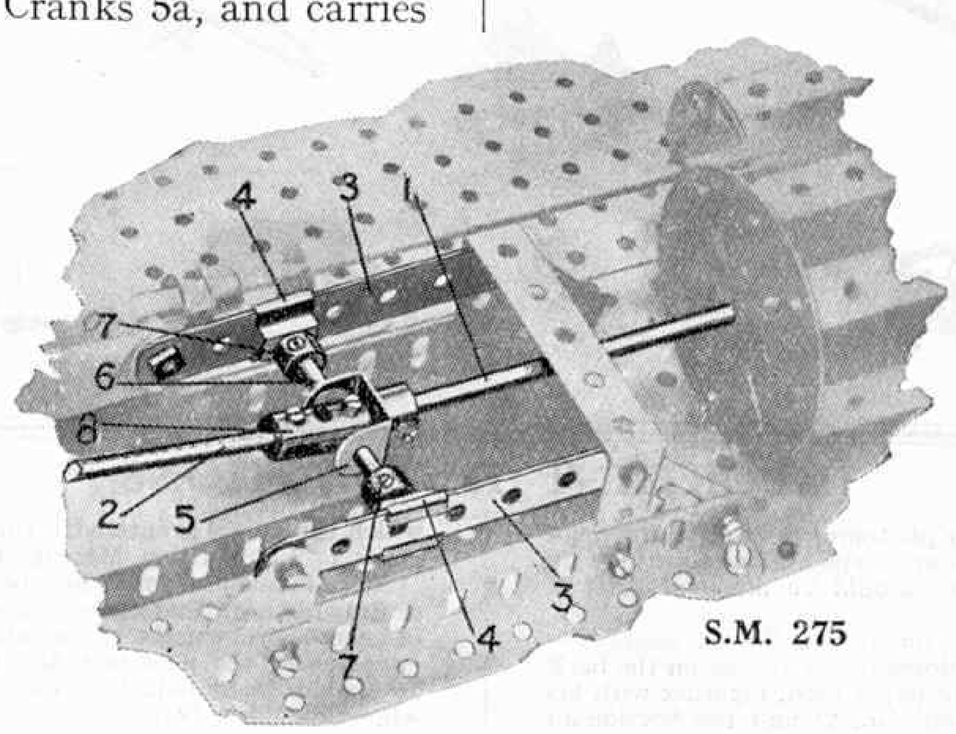
S.M. 274

S.M. 275—Crosshead

The construction of a crosshead calls for much care, for a considerable amount of friction will be set up between the various sliding surfaces unless all the elements are properly placed in their relative positions. Special attention should be paid to mounting the connecting rod in correct line with the piston.

The crosshead shown in S.M. 275 is composed of a short Rod 6 loosely mounted in Eye Pieces 4 and held in place by Collars 7. A Fork Piece 5, mounted on the end of the piston rod 1, engages the transverse Rod 6, whilst on the latter is secured a Coupling 8 carrying the connecting rod 2. Washers should be placed on either side of the Coupling 8 to retain it in the correct position in the centre of the Fork Piece.

The Eye Pieces 4 engage the slide-bars 3 (3½" Strips) mounted in position in the base of the engine. The slide-bars, piston, and connecting-rod bearings should be oiled occasionally to ensure smooth running.



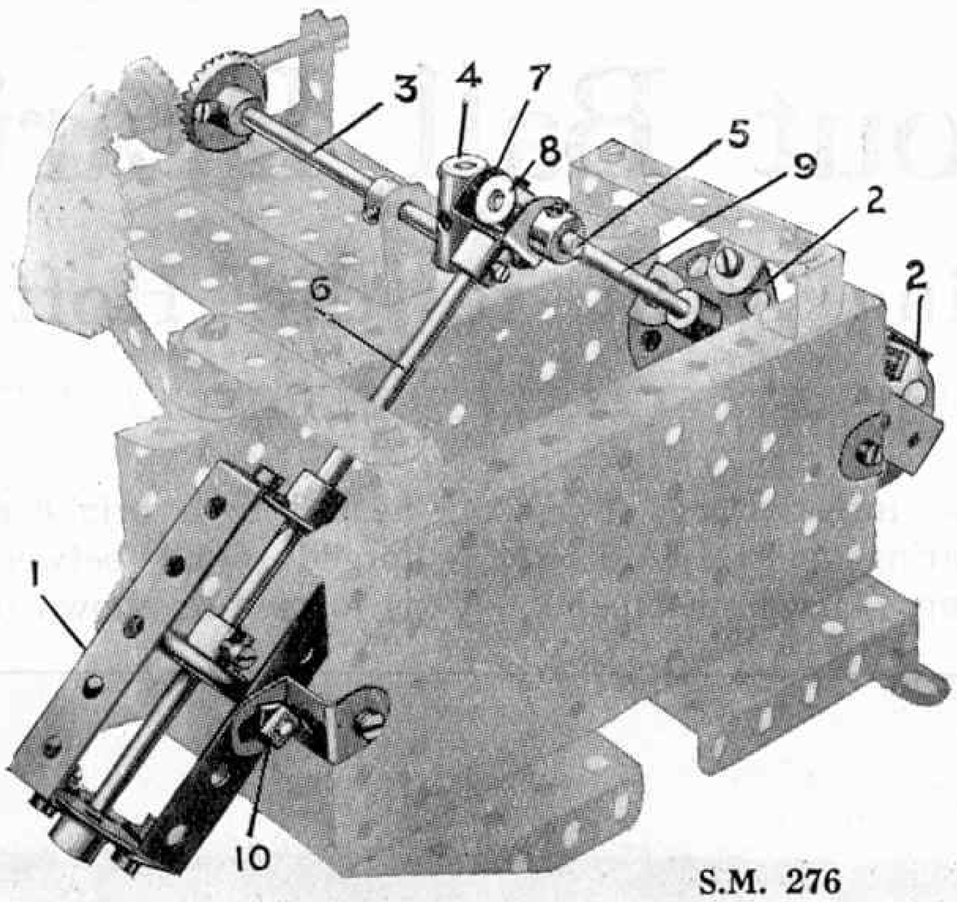
S.M. 275

S.M. 276—Oscillating Cylinders

Readers are probably aware that the oscillating-cylinder principle is applied to small steam engines, pumps, etc., to obviate the use of sliding valves. As the cylinder turns upon its pivot, it automatically uncovers first the inlet port in the steam chest and then the exhaust port. This arrangement also dispenses with connecting rods and crossheads, for the piston rod is attached direct to the crank pin. S.M. 276 shows how two oscillating cylinders may be connected to a single crank.

The cylinders 1 and 2 are pivoted at their centres by means of bolts and lock-nuts 10 (see S.M. 263) and the piston rods 6 and 9 are journalled on the crank

pin 5. The latter is secured in the end of a Coupling 4 mounted on the crankshaft 3. The piston rod 6 is pivoted to the crank pin by means of the Fork Piece 7, while the piston 9 carries a Coupling 8, through the transverse hole of which the crank pin is journalled. Washers should be placed between the Coupling 8 and the sides of the Fork Pieces.



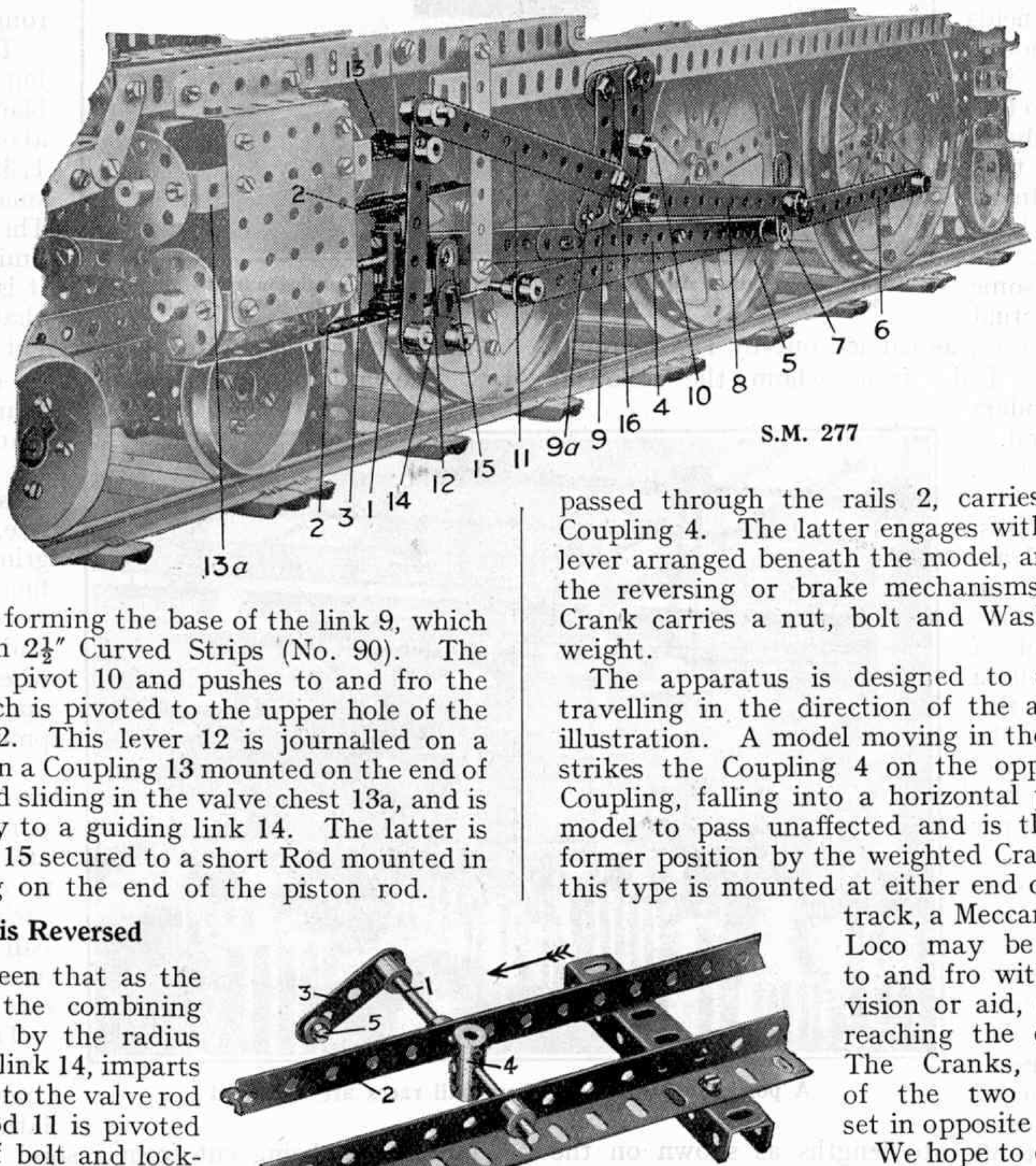
S.M. 276

S.M. 277—Walschaerts' Valve Gear

S.M. 277 illustrates an interesting model of Walschaerts' valve gear and also shows a typical Meccano connecting rod gear which is applicable to most types of locomotives.

The crosshead 1 is composed of a Coupling mounted between Eye Pieces engaging slide bars 2. A Strip Coupling mounted on the end of the piston rod 3 carries the connecting rod 4 pivoted to the crank pin in the centre driving wheel 5. The coupling rod 6 is also journalled on this crank pin and on the crank pins of the leading and trailing driving wheels, thus imparting the motion of the piston over the three wheels.

The crank pins consist of short Rods passed through the driving wheels and secured in Cranks bolted to their inner sides. A Crank 7 rigidly secured to the pin of the centre driving wheel 5 pivotally carries the return crank rod 8, and the latter is pivoted to the outer end of a short Slotted Strip forming the base of the link 9, which is constructed from 2½" Curved Strips (No. 90). The link rocks about a pivot 10 and pushes to and fro the radius rod 11, which is pivoted to the upper hole of the combining lever 12. This lever 12 is journalled on a short Rod secured in a Coupling 13 mounted on the end of the piston valve rod sliding in the valve chest 13a, and is connected pivotally to a guiding link 14. The latter is pivoted to a Crank 15 secured to a short Rod mounted in the Strip Coupling on the end of the piston rod.



S.M. 277

How a Locomotive is Reversed

It will now be seen that as the wheel 5 rotates, the combining lever 12, operated by the radius rod 11 and guiding link 14, imparts a sliding movement to the valve rod 13. The radius rod 11 is pivoted at 16 by means of bolt and locknuts to an Eye Piece, representing the link block, sliding on the strip 9a of the link 9. The link block is connected to a lever in the cab, so that the driver may move it to any position in the link that he may desire. This connection is not shown in the illustration, but Meccano boys should find no difficulty in devising a suitable control movement.

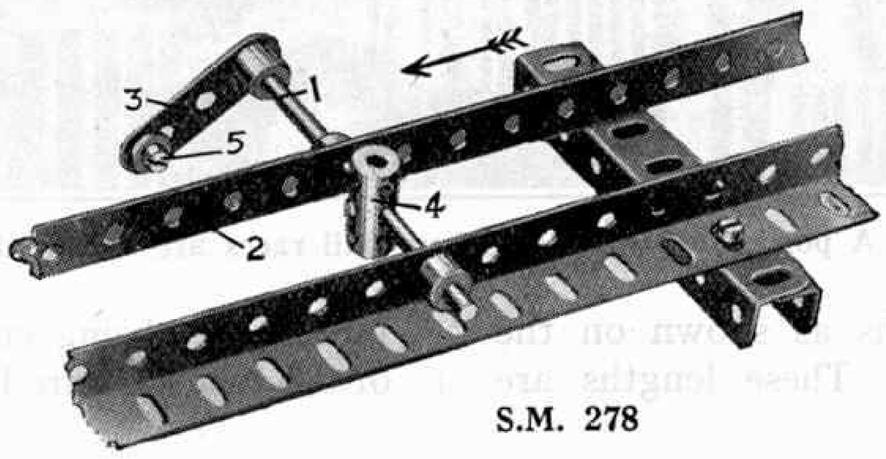
By moving the block 16 towards the pivot 10, the throw of the radius rod 11 is diminished, until it reaches its minimum when the block 16 is at the centre of the link 9. Further movement of the block to any point above the pivot 10 reverses the direction of the valve rod 13, and consequently reverses the order in which the cylinder valves open, so causing the locomotive to run in an opposite direction. The alteration to the throw of the radius rod also enables the driver to vary the amount of steam which is supplied to the cylinder for each stroke of the piston, for the inlet valve is held open for a short or long period according to the extent of the "throw" of the radius rod. This variation of the steam supply is known as the "cut-off."

S.M. 278—Automatic Brake or Reverse Device

This simple apparatus may be employed to operate automatically a brake or reversing gear in Meccano models that are required to travel upon rails. A Rod 1, passed through the rails 2, carries a Crank 3 and Coupling 4. The latter engages with a small projecting lever arranged beneath the model, and thereby operates the reversing or brake mechanisms. The web of the Crank carries a nut, bolt and Washer 5 as additional weight.

The apparatus is designed to affect only models travelling in the direction of the arrow shown in the illustration. A model moving in the contrary direction strikes the Coupling 4 on the opposite side and the Coupling, falling into a horizontal position, allows the model to pass unaffected and is then returned to its former position by the weighted Crank 3. If a lever of this type is mounted at either end of a single length of track, a Meccano model or Hornby Loco may be allowed to travel to and fro without outside supervision or aid, or fear of its overreaching the ends of the track. The Cranks, or balance arms of the two levers should be set in opposite positions, of course.

We hope to describe in a future issue an entirely revised model of the Meccano Chassis.



S.M. 278

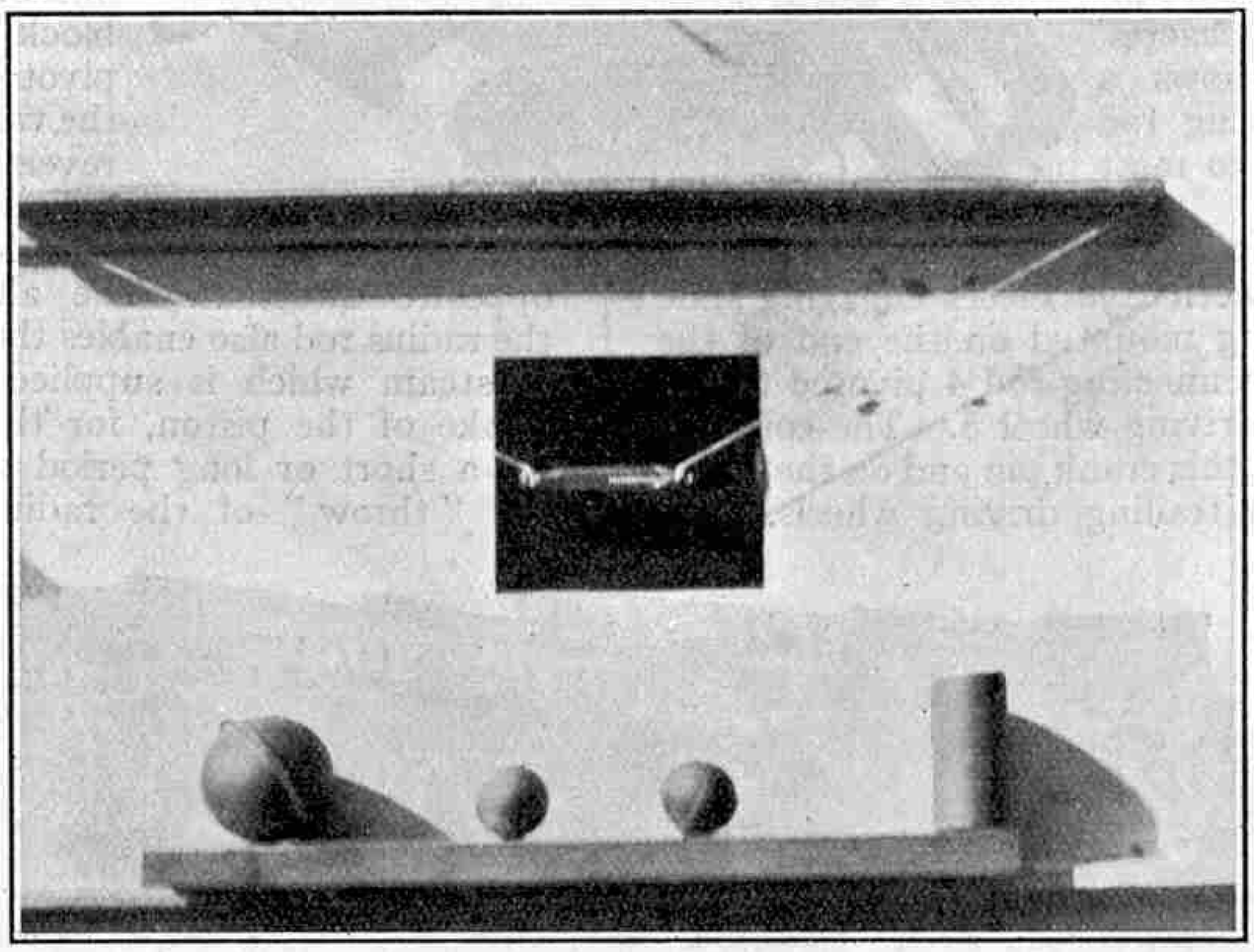
About Ball Bearings

An Interesting Visit to the Hoffman Factory

THERE is no doubt that the introduction of accurately made "Ball Bearings" has rendered possible many engineering accomplishments, which without them would have, even to-day, remained impossible.

Roller bearings have their set place in mechanical designs, but they are of much more limited application than the ball bearing we know so well.

Thirty years ago, hard steel balls were running in cone bearings in the best bicycles. This was one of the wide fields of application, although at that time it was quite exceptional to find them in other mechanical work. To-day, they are embodied in almost everything that is built to a high standard. We are able to give some account of the actual process of manufacture, as carried out by The Hoffman Manufacturing Co. Ltd., from whom the following interesting particulars have been obtained.



Ball bearings in various stages of manufacture. The glass tube hanging in front of the black square contains a number of balls 1/32nd of an inch diameter, the smallest size made

In the first place, let us take the manufacture of the balls. All sizes up to $\frac{5}{8}$" are produced cold in machines that receive the end of a coil of soft steel, cut off a slug and jump this up between dies. The balls subsequently roll down a chute at the rate of 150 to 200 per minute.

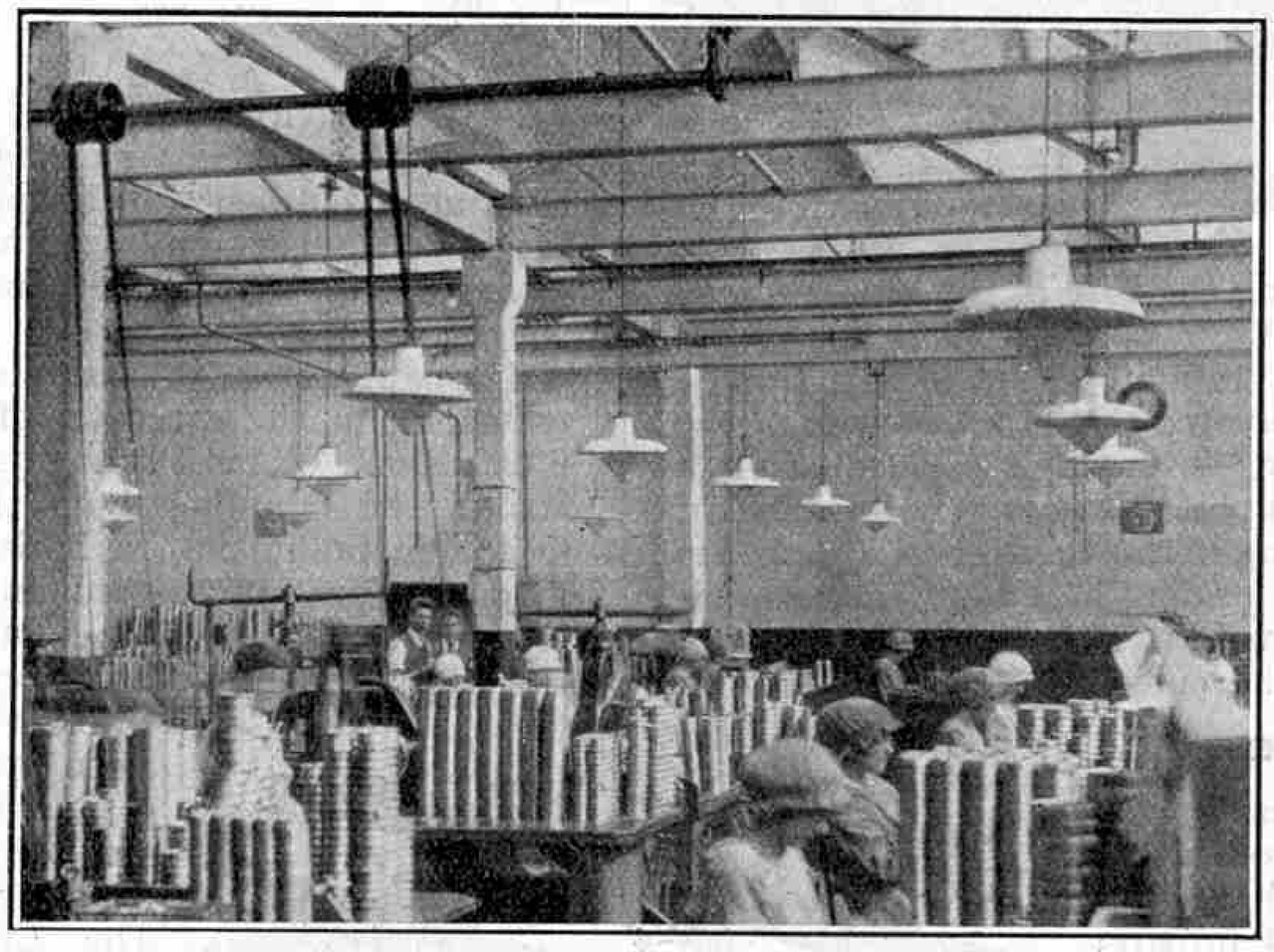
The accompanying illustration shows on the right hand side a small ball in the state in which it comes from the machine in question.

Balls of $\frac{3}{4}$" diameter and upwards are forged hot. In this process, the material is cut off into lengths as shown on the extreme right of the illustration. These lengths are heated to a bright red heat in a small furnace, and forged round between cup shaped dies, until a ball is formed as shown on the extreme left.

The next process is grinding, the machines being horizontal, similar to a lathe head stock with a large face plate, in which are a number of grooves. The balls are fed to the grooves down a chute with the necessary lubricant and the whole process is automatic. The small ball on the left hand side is in its rough ground state.

The glass tube hanging in front of the black square, contains about one dozen balls 1/32" dia., which is the smallest size made. These are naturally of limited application and it is a remarkable fact that they actually cost more to produce than their weight in gold!

The largest size of ball made is somewhere between four and five inches diameter, and is used for heavy gun mountings. But whatever the size, the process of fine grinding, polishing and, finally, finish polishing, is very much the same, and of course somewhere in between these operations comes the process of hardening.



A portion of the shop where ball races are inspected

All the balls are made to 1/10,000th part of an inch limit and though it is not necessary to measure each separate ball, every ball is subject to a most critical and final examination.

The manufacture of the ball races is accomplished in capstan lathes, the outer and inner races being cut from a solid bar and each stage of the manufacture has to pass through a rigid examina-

tion before passing on to another department. The lower illustration on the previous page, shows a portion of the shop where the races are made.

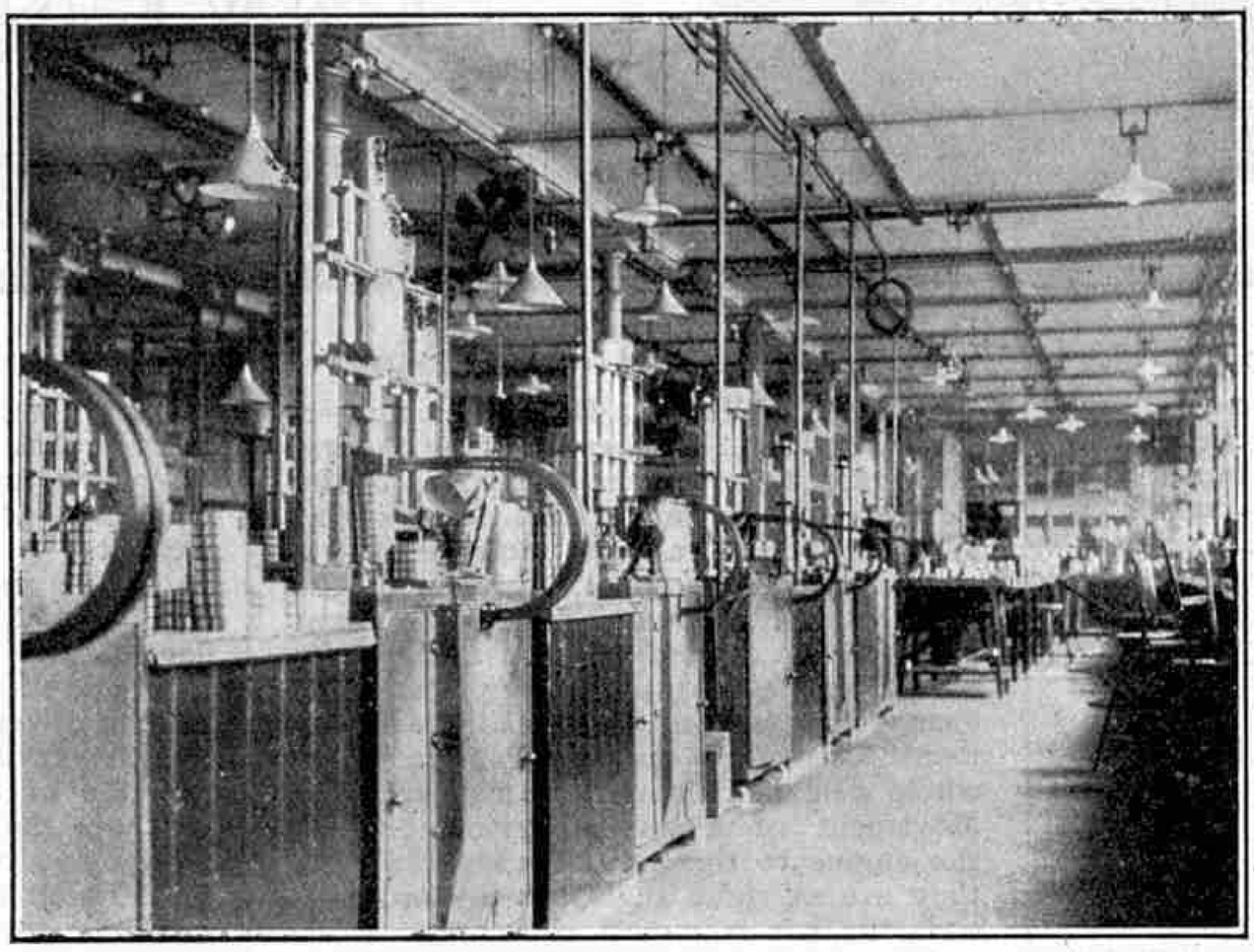
The measuring instruments employed for attaining the microscopic degree of accuracy necessary for a thoroughly satisfactory bearing are most ingenious. In one of them the infinitesimal degrees above and below 1/10,000th of an inch are shown on a large open scale. In another instrument, a column of pink liquid runs up a tube in the same way as the mercury ascends in a thermometer, and the tiny fractions of an inch are read with all the ease that one would ascertain the temperature.

The ring races are of course hardened and dealt with by grinding in the finishing operations in the same manner as the balls. The inner and outer races are dealt with upon a series of suitable machines, until at last hundreds of inner and outer races and great basketsful of balls finally reach the Assembly Department.

One of the most emphatic questions asked by everybody is "How do they get the balls in?" To do this, the outer ring is laid flat on a table, the inner ring placed inside and drawn out of centre until it touches the inner surface of the outer ring. This leaves a wide space in which several balls can be dropped. The balls are then worked round at either side of the centre ring, tending to force it more and more into the centre. At last, although the race is not full of balls, only one more can be got in betwixt the inner and the outer ring, before the centre ring is forced so much into the centre that the balls cannot be introduced between them. On counting up the number of balls thus introduced, it will be found that the balls, touching one another, will reach exactly half round the circumference of the race, with one ball more.

It remains now to fix the brass cage, and in doing so the balls are naturally spaced equally distant round the circumference of the race. The cages are introduced from each side of the bearing, and riveted together by the interesting machines shown in the upper illustration on this page.

The rivets that fasten the two sides of the cage together, having been placed in their respective holes, are subject to an electric current. This is sufficient to heat them until the ends can be closed by the small snaps already in position. The bow shaped conductors which carry the electric current for this purpose, are clearly shown in the photograph.

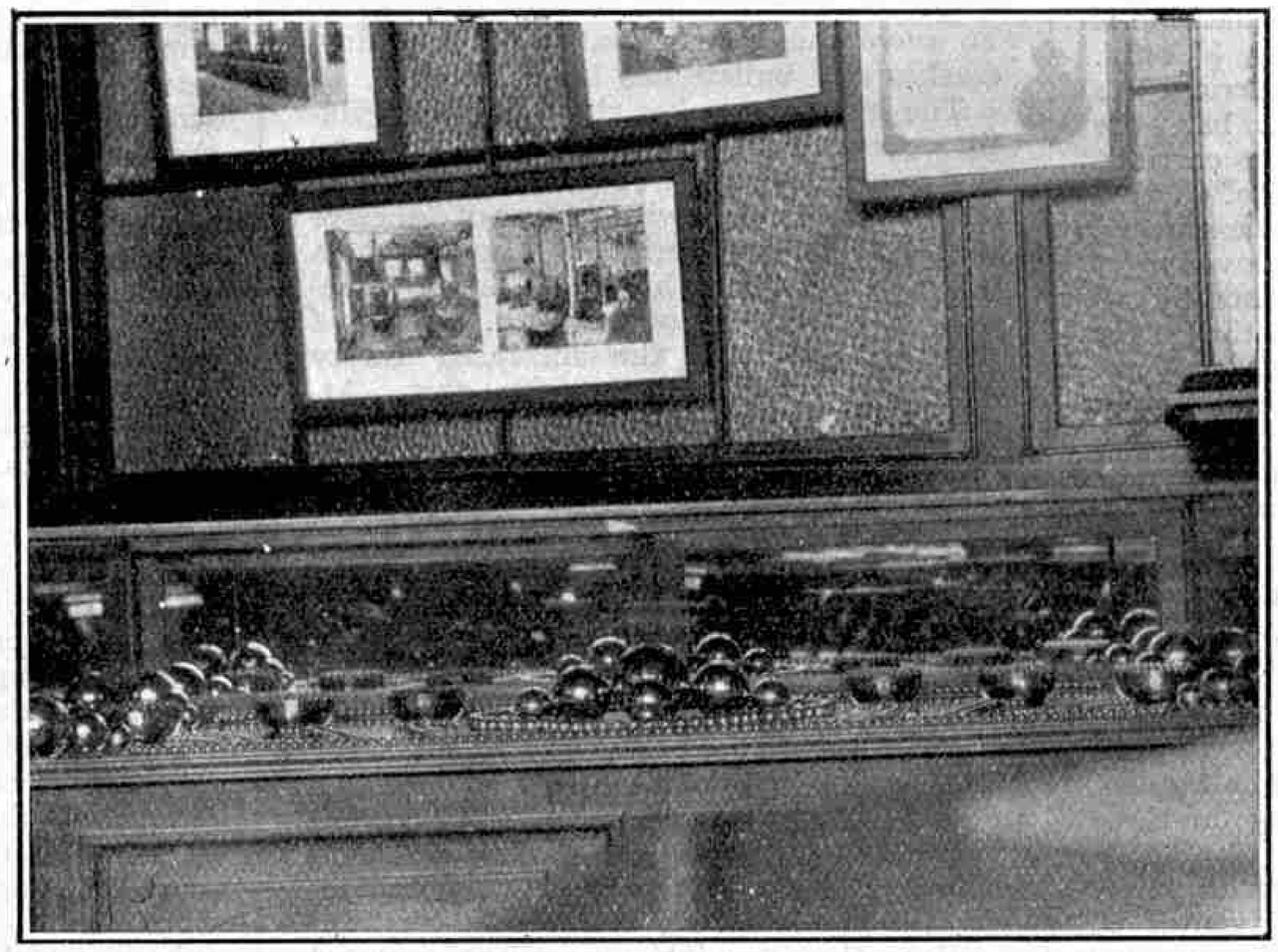


Some of the electric machines that rivet ball cages

Where the maximum number of balls is required in a bearing, a small notch is cut in one side of both the inner and outer races and additional balls are inserted through these notches. The process of fitting the brass cage is, of course, similar.

The lower block on this page illustrates a show case filled with a wonderful assortment of all sorts and sizes of balls, ball races, and practically everything to do with ball bearings.

Almost the whole area of the Hoffmann Manufacturing Co.'s fine works is one storey high, substantial brick buildings with toplight. In a tour of the works, it is only just possible to visualise the intricate system of check, counter check and inter-departmental organization that is necessary to produce an output of such magnitude composed of so many parts.



A display case of ball bearings and ball races

The large number of operatives work under excellent conditions, and an atmosphere of smooth, orderly industry reigns in each department—until the lunch bell rings at 12.0. Our unfortunate representative, clutching his precious camera in both arms, was then completely submerged by a mass of girls charging down the corridor!

In conclusion, it may be added that ball bearings were introduced in the first place with a view to diminishing as far as possible loss of power through friction. The principle upon which ball bearings are based, namely, the substitution of rolling for sliding contact, is of immense antiquity.

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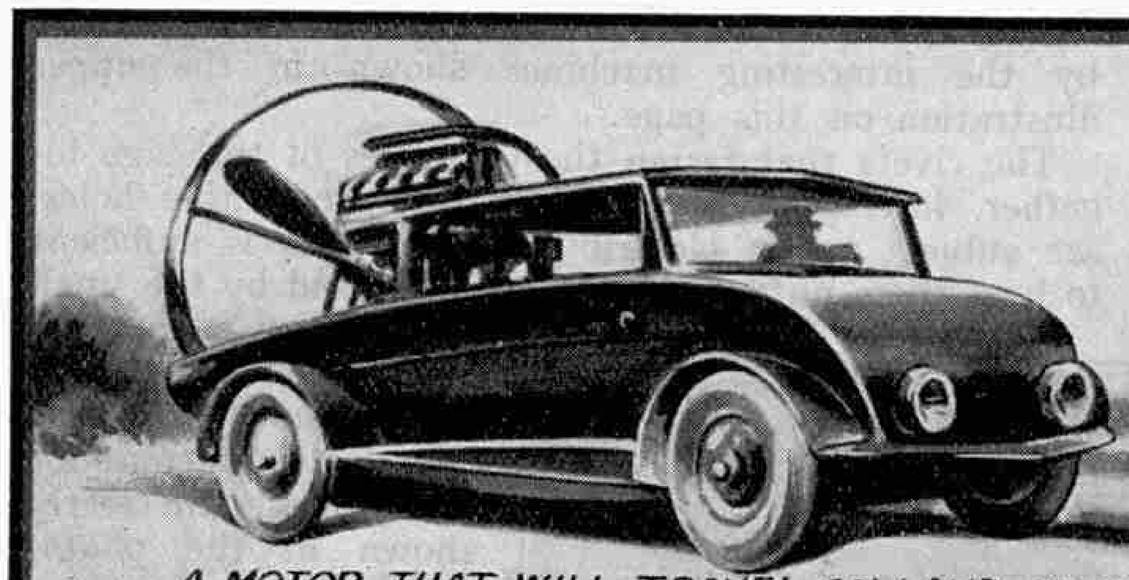


A MOTOR THAT WILL TRAVEL ON LAND OR WATER

OUR BUSY INVENTORS

RECENT INTERESTING PATENTS

Traffic Control Lamp

A new wrist lamp for the use of policemen on night point duty has been introduced. An ordinary bulb, contained in a casing something like a large watch is secured to the wrist of the officer's signalling arm, and is supplied with current by a small pocket battery. Included in the case is a quantity of mercury or quick silver, so placed that its movement closes the battery circuit when the policeman raises his arm. Thus the light is switched on and off automatically as the policeman gives the necessary traffic signals.

* * * *

Electric Typewriter

A typewriter operated by a small motor is a most interesting departure from ordinary principles. By means of carefully adjusted driving gear, the slightest depression of a letter key of this typewriter causes the motor to come into operation and to conclude the work of typing that particular letter.

The use of this invention will make typing much easier. The average machine requires a tapping pressure of about 10 ozs., the key being depressed through a distance of about $\frac{5}{8}$"; but the finger pressure required with the new machine is only $\frac{1}{4}$ oz., the depression being $\frac{1}{8}$" only. Further, all movements of the carriage are effected by merely touching a bar, the physical effort of shifting the carriage being practically done away with.

Perhaps the most ingenious feature of the machine, however, is the provision of a pressure-regulating device, whereby all the characters are printed on the paper with a uniform pressure. This pressure can be varied by means of the regulator when copies of the original are required, as many as twenty carbon copies being possible with the maximum pressure.

* * * *

Motor Driven Wings

Many attempts have been made to imitate the flight of birds, the best known of these being that of Lilienthal at the end of the nineteenth century. His flight could be better described as a glide, and it was while experimenting on these lines that he lost his life.

The advent of small but powerful petrol motors has led an Austrian inventor to the production of a remarkable apparatus for this purpose. The motor is contained in a case strapped to the back of the flier, and actuates two whirling helical screws that give a lifting movement. In addition it is geared to produce movements of two large fabric wings in imitation of those of the wings of a bird. The inventor has succeeded in making short flights at a height of 150 feet with his novel machine.

A Motor Car that Runs Sideways

Vollor P. Williams, a Baltimore engineer, has invented an auxiliary gear by the use of which a motor car may be moved bodily sideways. Four small, solid-tyred wheels are carried on extra axles below the chassis of the car, and are usually hidden by the main wheels. By moving a lever a worm gear is set in motion that causes the extra wheels to descend until they touch the ground, and a continuation of the movement forces the car upwards until the whole weight of the car is borne by them. Movement of a second lever connects the engine to these small wheels, and as they are at right angles to the ordinary ones the car is moved sideways.

Advantages gained by the use of this system are many; chiefly, easier parking of cars in restricted spaces, and elimination of jacks when punctures are to be repaired.

* * * *

A Bullet-Proof Petrol Tank

When an aeroplane crashes, there is always a great risk of fire arising from the spread of petrol if the tank bursts, and as this almost always results in an explosion, rescue is rendered practically impossible. To avoid this a tank that is proof against crashes and bullets has been invented.

The invention takes the form of a gelatinous material that can be melted and cast round any form of petrol tank. The latter is first coated with a layer of adhesive varnish. The material is applied in a layer half-an-inch thick, and adds somewhat to the weight of the tank. This is a disadvantage, but the increased safety more than compensates for this. Attempts to make a tank so coated leak by firing revolver bullets into it failed, as did other efforts in which it was thrown violently down on a stone floor, and in each case the external application of a flame after this violent treatment did not produce a fire.

* * * *

A Fruit Testing Instrument

The usual way of testing the ripeness of fruit is to press the latter between the finger and thumb. This method not only spoils the fruit by bruising it but is uncertain in action.

Recently a new instrument was patented for testing the ripeness of skin-fruits mechanically. In this machine a small piston is pressed into the fruit, the pressure required to break the skin being recorded on a scale. After a few trials, the ripeness of the fruit can be accurately estimated from the recorded pressure. This instrument is now in use on several large fruit farms.

More Agony at the Dentist's

In order that the testing of our dental nerves shall be an accurate mechanical operation, another instrument of torture has been placed at the disposal of the dentist.

A glass rod extends from a holder and has exposed electrical conductors at its lower end. The operator places this rod against the tooth to be tested and turns on the current by means of a small finger switch on the holder. By noticing the reaction of the patient, the dentist can estimate the vitality of the nerve. Coils of varying resistance are included in the holder and connected to various switch-contacts so that a current appropriate to the age and health of the patient can be used.

* * * *

Time Saving Alarm

Hamilton, Lanarkshire, has the distinction of having the first loud-speaker fire alarm installed in Scotland.

When the alarm is given by breaking the glass, the door of the fire alarm box flies open and direct telephone communication with the fire station is set up automatically. The fireman on duty at the station can then speak through the amplifier at his end, and his voice will be heard 12 or 14 feet from the box in the street. Through an aperture in the box the person giving the alarm will be able to speak to the station and describe the position of the fire, its nature and size, so that proper equipment can be brought and time saved.

* * * *

New Wall Plug

A new type of wall plug that appears to possess certain definite advantages over the familiar wood fibre plug, has recently been placed on the market. It consists of a thin strip of metal rolled in cylindrical form and requires only an ordinary triangular pointed punch to drive it securely into the hole prepared for it in the wall. A lip-like overlap extends for two-thirds of the length of the plug and merges into a tube-like section at one end. This lip ensures a tight fit when the plug is inserted in the hole and, further, prevents the plug from rotating when a screw is inserted. The first turn of the screw expands the tube-like end and drives the plug into a position that in reality makes it into a metal lining for the hole.

The firmest hold obtained with this type of plug—it is known as the "Metlex"—is that provided by an ordinary wood screw which cuts a well defined thread inside the plug and can be removed and replaced without impairing the efficiency of the combination.

A Fuel-Saving Kettle

One of the most profitable fields to which inventors have turned their attention in recent years has been that of domestic appliances, and one of the most interesting recent inventions of this type is a flat sided kettle, intended for use with the double type of saucepan that is rapidly becoming popular. The double saucepan is semi-cylindrical in shape, so that when two are placed together they have a form similar to the old-fashioned cylindrical saucepan, but with the advantage that the two compartments will cook different articles over the same circular gas ring. The new kettle is designed so that it may be placed between the two halves of the detachable saucepan and thus the three utensils can be placed over one ring.

This ingeniously shaped kettle is known as the "Bolton" kettle and is fitted with a patent lid that will not fall off, no matter to what extent the kettle is tilted. On the other hand the lid requires no special adjustment and comes away quite easily when lifted.

* * *

Aerial Photography at 35,000 ft.

A camera recently designed by the Kodak Company for use by the American Army Air Service should achieve records in the way of effective long distance photography. The camera can take photographs that will clearly record detail at an altitude of 35,000 ft. or nearly seven miles! Special sensitized film and a special light filter will be employed. The film will be wound on spools each of which will provide material for 100 exposures, each exposure being upon a strip of film nine inches square. Some idea of the size of the camera will be gained when it is stated that the lens mount is nine inches in diameter!

* * * *

Electricity from the Wind

A novel and effective windmill dynamo combination that should prove of considerable value to residents in small houses situated at a distance from ordinary electricity supply mains has recently been produced in France.

The device consists of a wind rotor, working on the turbine principle, and rotating about a vertical axis. The rotor is housed in an outer casing that functions entirely independently from the axle of the turbine and is equipped with a directional vane that swings the casing always to face into the wind.

In a steady breeze of about six m.p.h. current begins to flow into the storage batteries. In a wind of average strength the output varies between 3 and 14 watts, and in strong winds is about 18 watts. The actual output is regulated by three spring vanes. Two are placed in the mouth of the casing and regulate the speed in heavy winds, while the third acts as a brake on the turbine when the wind velocity exceeds a certain pitch.

Sponge Rubber

The use of sponge-rubber as a stuffing for mattresses and cushions in place of the spring and customary hair or wool has been the subject of experiment by Hampton & Sons Ltd., of London, during the past two years. The cushions and mattresses are built up of strips and sheets of pure rubber, which are placed inside the usual type of cover. Several air vents are provided in the cover, but otherwise the appearance of the rubber product is precisely similar to that of other cushions and mattresses.

The sponge rubber provides a material of superlative resiliency and after being subjected to local pressure for considerable periods, the parts compressed resume their previous level. Another important virtue is that sponge rubber is vermin-proof, for vermin dislike rubber and avoid it most carefully.

* * * *

A Permanent Paint

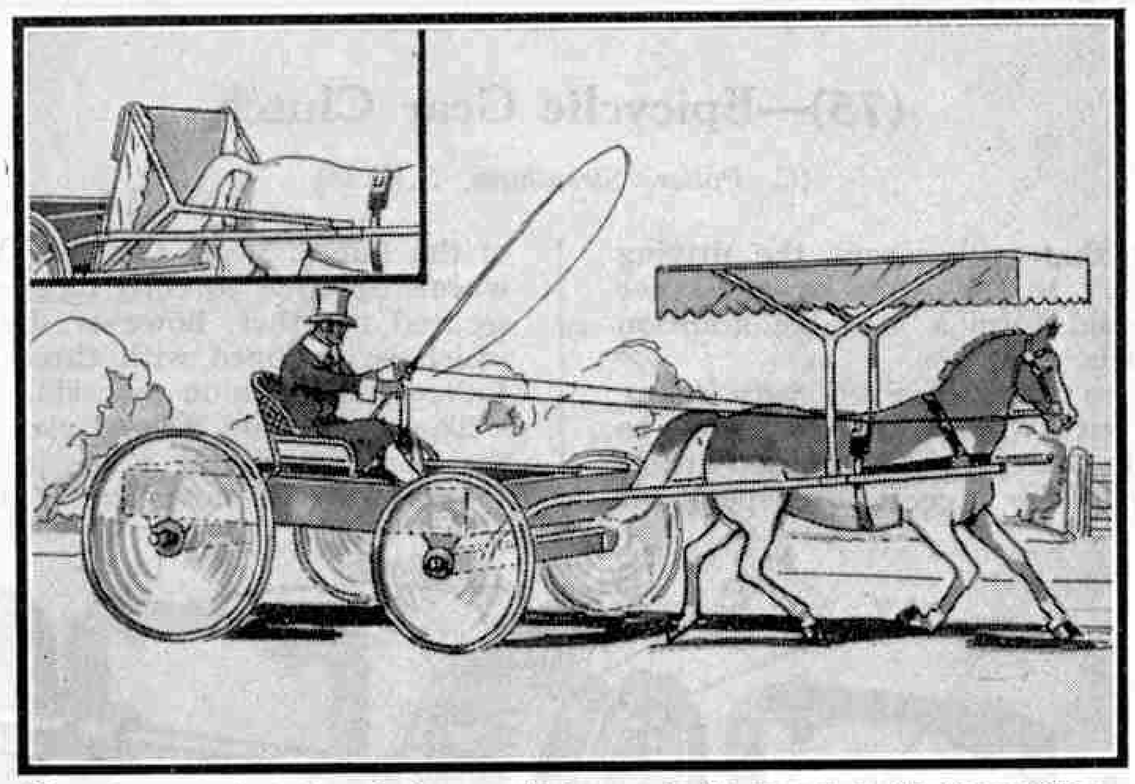
A Swiss scientist has produced a new paint for use on iron structures, and claims that the new pigment will afford a permanent and completely rustproof protection for metal.

The paint is produced by melting lead in an electric furnace and blowing through it air and certain gases. In this way is formed a dross consisting of a mixture of very fine particles of lead and yellow lead oxide. When powdered and mixed with specially prepared linseed oil, the mixture is ready for application as paint, and it has been found that actually large numbers of the small lead particles leave the pigment and penetrate the surface of the iron object that has been painted. Prolonged exposure to severe weather is stated to have had absolutely no effect on articles so painted.

* * * *

A synthetic form of resin that possesses many of the characteristics of glass has been produced by Dr. Pollak of Jena. The resin is hardwearing, transparent and being unsplinterable would appear to fill the want for a glass of this type.

Curious Ideas of Inventors of the Past



Plans for many ingenious devices are filed away in the records at the Patent Office. Our illustration shows an idea, conceived in 1888, for an elaborate awning to shade carriage horses from the sun! The device was to be supported by the shafts and the small drawing in the top left corner indicates how the awning was to be folded back, so as to be out of the way on sunless days

Making Speech Visible

The fact that the stressing in speech of any vowel calls for an increased muscular effort of the jaw, the movement of which actually can be made to reproduce the spoken word in a written form, is the basis of an invention by a Professor of University College, London.

The invention consists of an instrument that records on a photographic film a graphic curve reproducing exactly the sound and jaw movements, from which it is possible to read the actual spoken words. The system of recording consists of placing the subject of the tests in a darkened room and attaching a pin-light to his jaw. The film is then set in motion and the movements of the light are recorded on it.

The instrument will prove of use in all cases where proof of coherent speech is required. For example, a drunken man when arrested is usually required by the police to repeat certain words that are calculated to prove a stumbling block to anyone whose speech is thickened by undue indulgence. Hitherto the evidence of the police officer as to the result of such a test has had to be accepted uncorroborated, but the new form of speech record will present a clear, incontrovertible report. If the words are spoken clearly the rise and fall of the sounds will be clearly defined; whereas if the speech is incoherent the graph will show blurs for consonants and only slightly-defined dips for vowels.

* * * *

Old Inventions Re-discovered

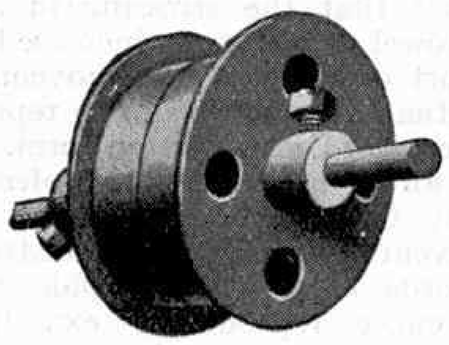
In the *"M.M."* for May last, the Editor referred to the invention of flexible glass, and narrated the sad fate of a Roman inventor of a similar material 2,000 years ago. But it seems that even the Roman was not the original inventor, who must have lived more than 5,000 years ago. The authority for this statement is a record of an early Arab explorer of the tomb of Cheops, builder of pyramids. The explorer was El Mamoum, son of Haroun-al-Raschid, of *"Arabian Nights"* fame, who found in the tomb glass that could be bent and not broken.

As if this were not enough, he also found weapons that did not rust, so that the Sheffield discovery of stainless steel appears to have been forestalled!

* * * *

No More Double Exposures

Amateur photographers will be particularly interested in the announcement that a "fool-proof" camera designed to prevent a second exposure upon an already exposed piece of film has recently been patented by Mr. M. E. L. Christensen, a Norwegian inventor. The camera incorporates a self-locking device that operates automatically after each exposure and prevents the shutter from again being used until the completion of the action of winding a fresh strip of film into place.



Meccano Belt Pulley, constructed from two Flanged Wheels

Suggestions Section

Edited by "Spanner"

(75)—Epicyclic Gear Clutch

(C. Potter, Streatham, S.W.16)

AN efficient clutch movement that will permit the driving power to be applied gradually to the load, or resistance that is to be overcome, should form a valuable addition to a large number of Meccano models.

During the past few months we have received very many suggestions for frictional clutches with which this result may be obtained, and we intend to deal with one or two in a special article in the near future. The majority of the suggestions depend for their action, however, upon the friction created between two revolving surfaces, one of which may be pressed against the other with varying force, and in order to secure the best possible results from such a device one of the frictional surfaces should be of some special material, such as rubber or leather, as in actual practice. On the other hand there is another form of clutch that employs spur gearing with which to obtain the required results. This is known as an epicyclic or "planetary" gear clutch, and C. Potter's model, which is here illustrated shows that it can be reproduced perfectly with standard Meccano parts.

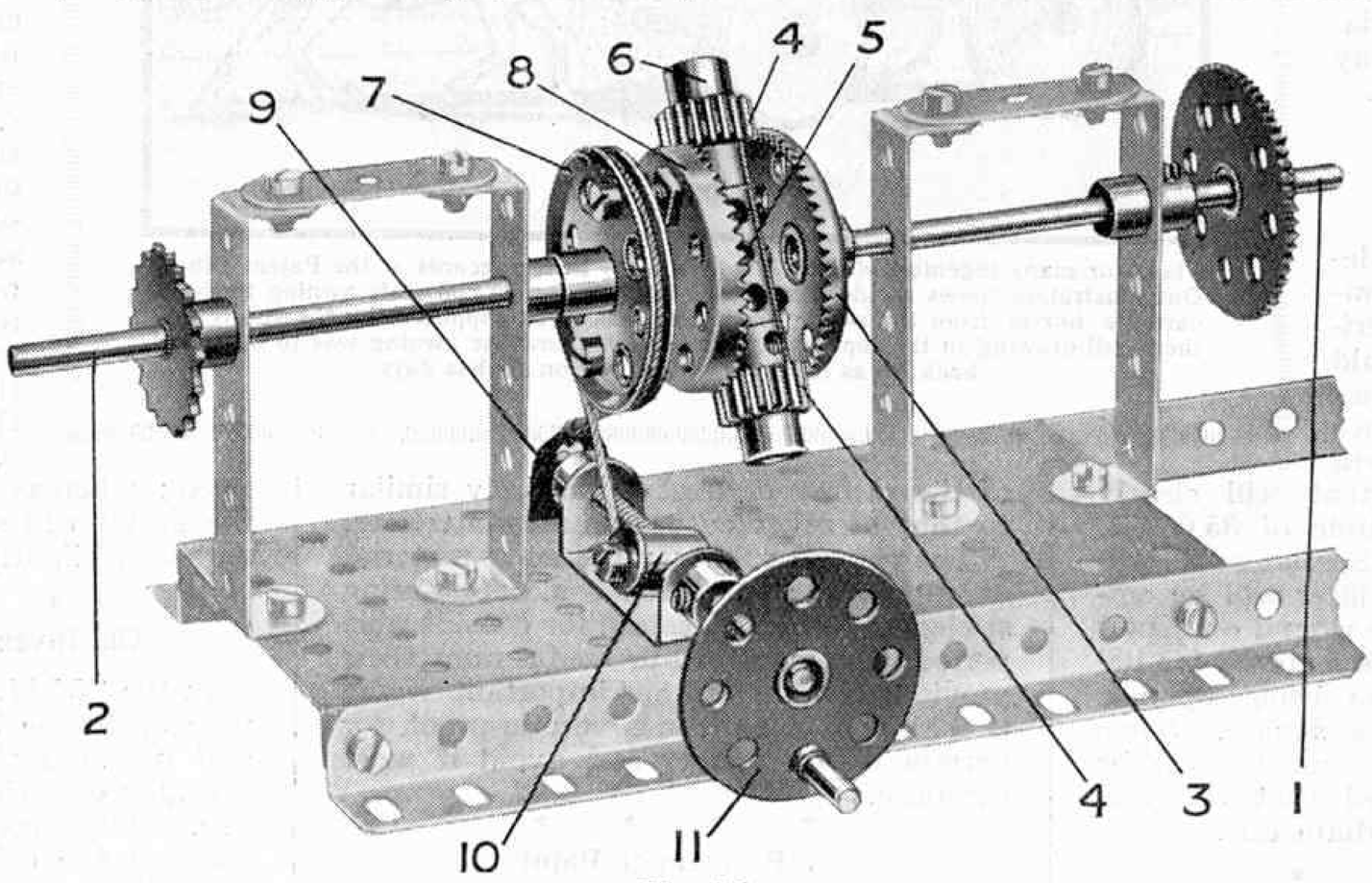


Fig. 75

As a rule, ordinary straight-toothed gear wheels are used in actual practice. This means that the Contrate Wheel 3 of the Meccano model would be replaced by a gear wheel and the axles of the Pinions 4 would be parallel to the shafts 1 and 2 instead of at right-angles to them. But this would necessitate the use of an internally-toothed gear wheel of sufficient diameter to completely encircle the gear wheel 3 and its pinions, the outer teeth of which it would engage. It is to obviate the necessity of such a part that the second Contrate Wheel 8 has been introduced. Incidentally, this explanation should make the description "planetary" more obvious, for the movement of the pinions round the gear wheel is similar to the "Sun and Planet Motion" described in the May (1926) Suggestions Section.

Construction of the Model

Two Rods 1 and 2 are mounted in direct line with one another in any suitable bearings. The Rod 1 is the primary, or driving shaft and Rod 2 is the secondary, or driven shaft. The former is gripped by the set-screw of a 1½" Contrate Wheel 3, the teeth of which engage with ½" Pinions 4 mounted on 1" Axle Rods secured in the ends of a Coupling 5. The grub screws having been removed, the Pinions are free to revolve on their axles, but they are held in place by the Collars 6.

The Rod 2 passes through the bosses of a 1½" Pulley Wheel 7 and the second 1½" Contrate Wheel 8, and its inner end is secured in the centre transverse hole of the Coupling 5. The set-screws of the Pulley 7 and Contrate Wheel 8 are removed so that both wheels are free to turn independently of the Rod 2. They are secured together, however, by means of two ½" Bolts, each of which is equipped with three nuts, one immediately behind the Pulley 7 and one on each side of the Contrate Wheel 8.

The unit 7 and 8 is so placed upon the Rod that the teeth of the Contrate Wheel 8 are in constant engagement with the ½" Pinions 4. The movement of the Wheel 7 is controlled by a friction brake consisting of a length of cord, one end of which is tied to an Angle Bracket 9 in the base of the model and the other end to a Threaded Boss 10 mounted on a Threaded Rod journalled in a convenient position near the wheel 7. This Rod carries a hand wheel 11 and is prevented from moving longitudinally in its bearings by a pair of Collars with set-screws. It will be seen that this brake resembles Standard Mechanism No. 86 (Strap and Screw Brake).

If the brake is in the "off" position, that is with cord slack, the unit 7 and 8 is quite free to revolve about the Rod 2. Hence if power is applied to the Contrate Wheel 3 the Pinions 4 commence to turn upon their axles, driving the Contrate Wheel 8 in an opposite direction, and no movement is imparted to the Rod 2.

Suppose that the hand wheel 11 is rotated in a clockwise direction, so gradually applying a braking effect on the Pulley 7. The Contrate Wheel 8 now becomes increasingly difficult to turn, and the Pinions 4 commence to climb round its teeth, thereby rotating the Coupling 5 and the Rod 2.

It will be seen from the above that by means of this clutch the power can be applied to the load very smoothly and without shock, for the Rod 2 commences to rotate immediately the resistance on the Pulley 7 becomes greater than the load (that is the resistance on Rod 2). The speed of the latter Rod increases in proportion to the increase in the resistance on Pulley 7 and the maximum speed is reached when the movement of the Pulley ceases altogether. It should be noted that the arrangement of the gearing is similar to that described under Suggestion No. 70 (Epicyclic Transmission Gear) and a ratio of one in two is obtained when the unit 7 and 8 is immovable—that is, the Rod 2 rotates only once in every two revolutions of Rod 1.

The type of brake used may vary, of course, according to the requirements of the particular model in which the device is incorporated, but the screw-operated brake is the best in nearly all cases, for it permits of the gradual application of the retarding effect.

When the clutch is "out" *(Continued on next page, column 3)*

(76)—Meccano Bicycle Brake

(L. P. Storey, Clifton, Bristol)

We continue to receive from time to time examples of the numerous practical purposes to which Meccano may be adapted. One of the latest to be brought to our notice consists of an ingenious foot brake fitted by L. P. Storey to his Raleigh bicycle.

The designer describes this as "a gradual brake, to be used in coasting down long hills, when the continued pressure of the hand brakes tires the hands." We hope it is not necessary to warn any reader who decides to fit a similar device to his bicycle that very great care should be taken in securing the various parts, and all nuts and bolts must be screwed very rigidly in position.

The lever 1 (Fig. 76) is in duplicate and in order to obtain increased rigidity is made up of six 5½" Strips, three Strips being placed together on each side of the bicycle frame bar and pivoted by bolt and lock-nuts (see Standard Mechanism No. 262) to a 5½" Strip 2 clamped round the bar. A 2½" × 2½" Flat Plate 3 is bolted to a 1½" Double Angle Strip and is kept in place by two 1½" Strips 4. This serves as the operating pedal and a 2½" × ½" Double Angle Strip 5 bolted to the plate forms the heel-rest. 2½" Strips 6 are bolted to each set of 5½" Strips 1, and are kept in place by two 1½" Strips.

A fourfold 2½" Strip 7 (i.e., four 2½" Strips placed together) is bolted to the Raleigh brake clip 8 on each side of the bicycle frame, and is connected to Strips 6 by a link 9 (three 5½" Strips placed together) and at the junction between Strips 7 and 9 a brake block 10 is secured as shown in the drawing. The brake is normally held in the "off" position by a powerful spring 11 attached to a 1½" × ½" Double Angle Strip, which connects the two sets of Strips 6 together, and fastened at the other end by a piece of copper wire 12 attached to a 5½" Strip 13 clasped round the frame bar.

When pressure is exerted by the heel on plate 3, the Strips 9 move in a direction away from the rear wheel, thereby applying the brake blocks to the rim. The mechanism shown in the drawing is duplicated on the other side of the bicycle. Our contributor covered the various parts of the brake with insulating tape to prevent rust.

A very powerful spring is necessary at 11 and the Meccano Spring (Part No. 43) is therefore unsuitable. The spring used in L. Storey's apparatus cost 8d., and no doubt a similar one may be obtained from any cycle or hardware dealer. The brake blocks may be purchased for a few pence each. If it is required at any time to strengthen the spring 11, the position of the clamp 13 on the bar may be raised.

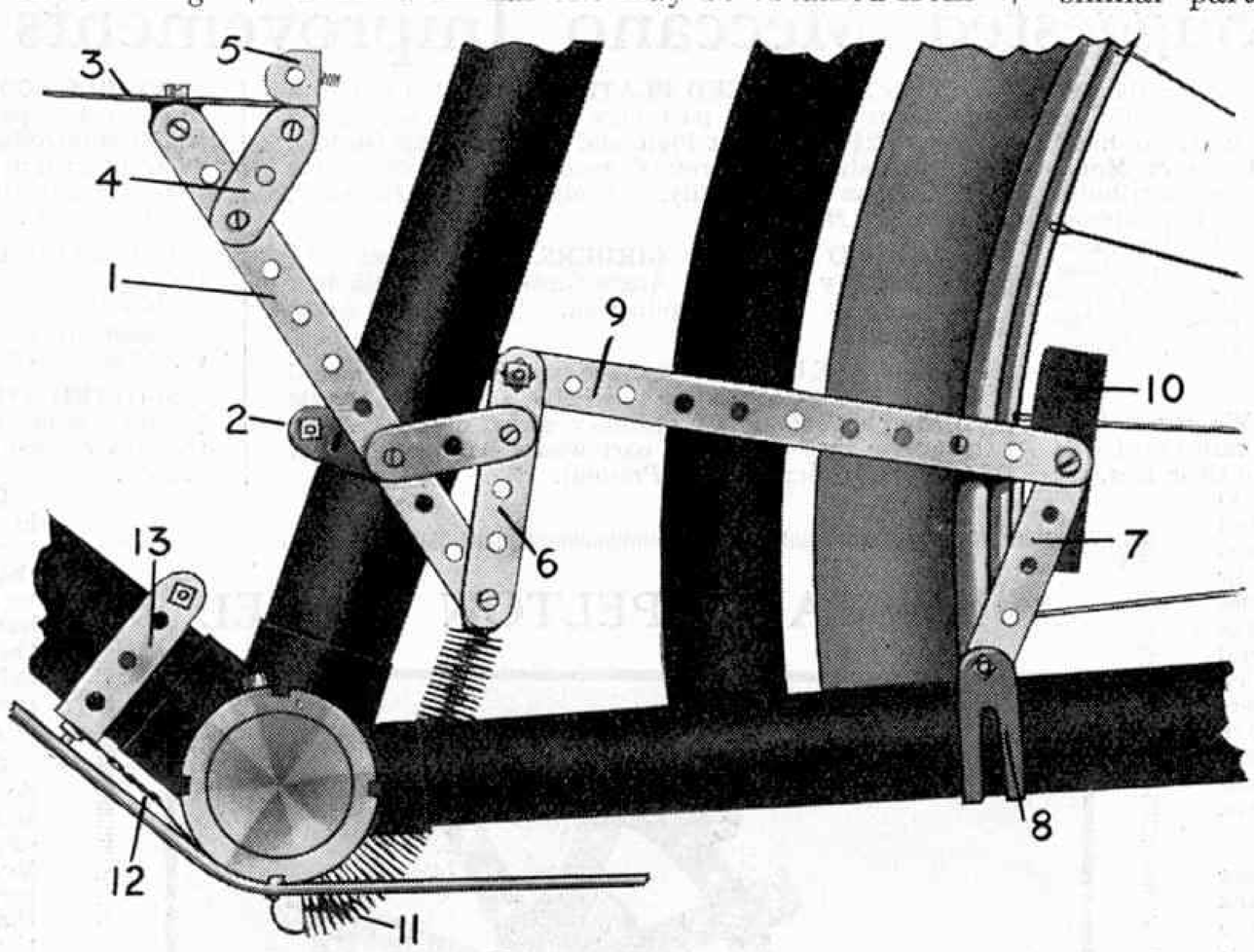


Fig. 76

Parts required:

14 of No. 2	1 of No. 48A
10 ,, ,, 5	1 ,, ,, 72
4 ,, ,, 6A	2 Brake Blocks
25 ,, ,, 37	1 Strong Spring
5 ,, ,, 37A	Small piece of Copper Wire
3 ,, ,, 48	

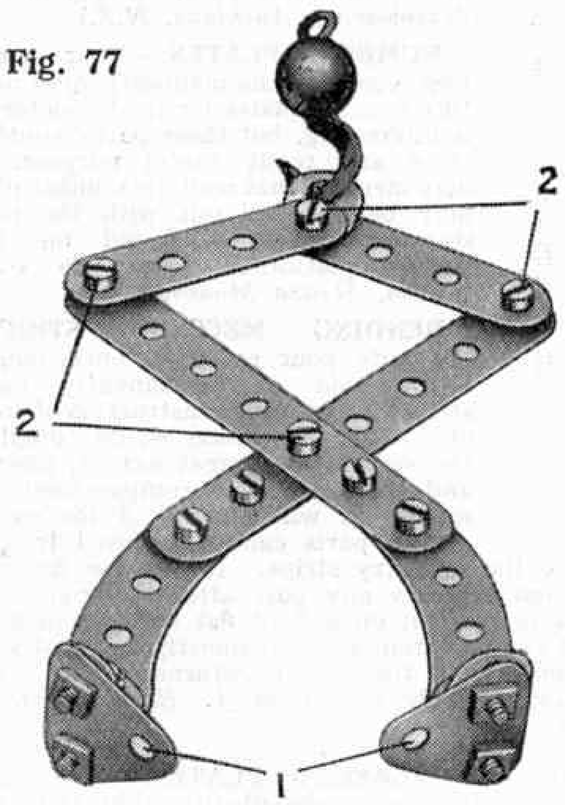


Fig. 77

(77)—Friction Grip Tongs

(P. Harrad, Prestwich, Manchester)

In the July 1926 "*M.M.*" we described a Meccano friction grip, or lever grip tongs, of the type used in block-setting cranes. We have now received a suggestion for a similar device that is both simple in design and efficient in operation. The apparatus is illustrated on this page and it will be seen that it may easily be attached to any Meccano crane.

Each arm of the "tongs" consists of a 3½" Strip and a 2½" Curved Strip (large radius) overlapped two holes and bolted together. Each "jaw" consists of a 1" Triangular Plate 1 bolted to a pair of Angle Brackets secured one on each side of the Curved Strip. All the bolts 2 are secured by lock-nuts to allow for free movement of the various parts of the tongs.

Miniature stone blocks, weighted boxes, etc., may be lifted with this apparatus, provided that their width is not too great to pass between the jaws 1. There is no fear of the load slipping out of the grasp of the tongs, for the grip of the jaws increases in proportion to the weight of the load to be lifted.

(78)—Connecting Rod End Bearing

We have received a number of queries from readers regarding the construction of a connecting rod for use in conjunction with the Meccano Crankshaft (Part No. 134). These queries appear to be prompted by the fact that the angles of the Crankshaft are too sharp to allow Couplings and similar parts to be placed in the centre of the crank. Fig. 78 shows a simple and realistic "big-end" bearing, however, which should solve our readers difficulties in this connection.

It will be seen that the bearing consists of two 1½" Strips mounted on the crank and bolted to a Coupling 1 secured to the end of the connecting rod 2. The Strips are held in place by a ½" Bolt 3 passing completely through the end of the Coupling, and by a pair of set-screws 4, which serve also to grip the connecting rod in the Coupling. The position of the connecting rod in the centre of the crank is maintained by a Spring Clip 5 mounted between two Washers.

A similar device suggested by J. Jackson of Thornton, Blackpool, makes use of two 1" Triangular Plates in place of 1½" Strips. The Plates are bolted one on each side of a Coupling that carries in its centre transverse hole a Pivot Bolt, the end of which is inserted in the end of an ordinary Coupling (Part No. 63) or a Strip Coupling (63b), so that either an Axle Rod or a Strip can be used as the connecting rod.

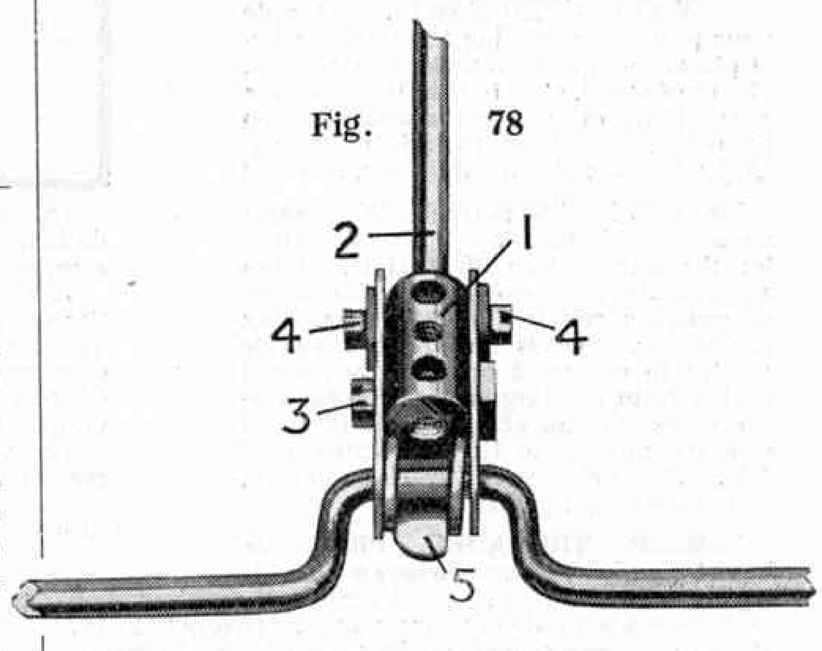


Fig. 78

(75) Epicyclic Gear Clutch—

(Continued from previous page)

with the brake fully released, the Rod 2 will still show a tendency to revolve if it is quite free in its bearings. This is due to friction in the gearing, which induces the Pinions to travel round the Contrate Wheel 8 rather than rotate the latter about the Rod 2. The tendency disappears, however, when the device is coupled up to a model, etc., for the resistance on Rod 2 is then usually greater than the friction between the gears.

The various moving parts of the clutch should be kept well oiled.

In Reply

In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Every idea, however, whether acknowledged in these columns or not, is carefully examined and considered.

Suggested Meccano Improvements

SPECIAL MECCANO SETS.—We are unable to adopt your suggestion concerning the supply of Meccano Outfits containing a set of parts to build some particular model, such as the Loom or Motor Chassis, etc., as one of the most important attributes of the Meccano system lies in the fact that almost any number of models may be built with the same parts. The contents of the present Outfits have been compiled after many years of experiment with a view to obtaining a collection of parts possessing the greatest possible number of adaptations. (*Reply to J. R. Thomas, Newport, Mon.*)

REPRINTING THE MAGAZINE.—We regret it is quite impossible to reprint back numbers of the "*M.M.*" so that readers may complete their files, for we should have to sell some 50,000 copies or so of any one issue so reprinted before we could hope to cover the enormous expense involved. We endeavour to supply early copies from our own files when specially requested, but of course these stocks soon become exhausted and there are now several issues of which copies are quite unobtainable. There is only one really efficient precaution to take against the misfortune of incomplete Magazine files—*i.e.* order your copies in advance! (*Reply to R. G. Slade, London, S.E.23*).

BINDERS FOR MANUALS.—There would be little demand for spring-back binders designed to receive the Meccano Instruction Manuals. A more satisfactory method by which the object you have in mind may be attained would be the addition of stiff covers to the Manuals, but we fear we are unable to adopt it since economy in cost of publication must be one of our chief considerations. (*Reply to George Maynard, Toronto*).

Suggested New Meccano Parts

NEW COLOURED PARTS.—We note your proposal regarding the introduction of plates coloured to represent brickwork, blocks of stone, etc., but we fear that the adaptability of such parts would be too limited to permit of their introduction. (*Reply to Colin Acland, Rockdale, N.S.W.*)

MECCANO SWITCHES.—We regret we are unable to adopt your suggestion for the introduction of special switches as separate Meccano parts. The types of switches required in model-building are very numerous and it is a simple matter to construct one to any desired design from existing parts. See Suggestions Nos. 64 and 65 (Knife Switch and Contact Button) in the November 1926 "*M.M.*" (*Reply to D. R. Heeramaneck, New Gamdevi, Bombay*).

LONGER THREADED PINS.—We have found few instances where a Threaded Pin with a longer screwed portion is required, but we have made a note of your remarks. (*Reply to E. W. Amos, Goodmayes, and L. Ison, Northcote, Victoria*).

½" SPROCKET WHEELS.—A Sprocket Wheel having a diameter of ½" would present no important advantage over the existing ¾" size. In addition, a considerable amount of friction would be created by bending the chain round so small a circumference. (*Reply to Raymond Russell, Taranaki, N.Z.*)

NEW CHAIN.—The design of a "silent" chain to engage the teeth of Meccano Gear Wheels is scarcely practicable, for the links would have to be very small indeed. You do not describe the particular chain you have in mind, but we doubt whether it is possible or even desirable to design a miniature chain drive to run more silently than the existing Sprocket Chain gearing. (*Reply to Raymond Russell, Taranaki, N.Z.*)

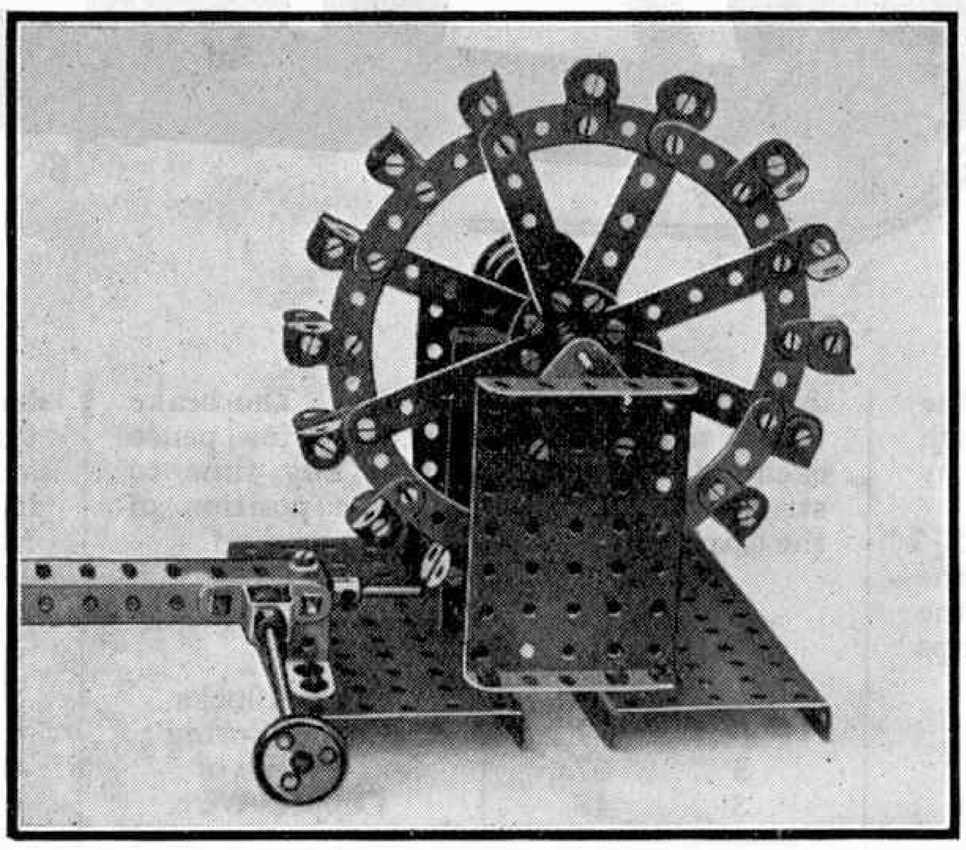
DEEPER GROOVES FOR PULLEYS.—We doubt whether any advantage would be obtained by increasing the depth of the grooves in all the pulleys. There are a few exceptional cases, of course, where a very deep groove is required for a guide pulley or sheave, and in this connection we would refer you to Standard Mechanism Nos. 39a and 155. (*Reply to Clifford Caswell, Featherstone*).

2½" × 2½" FLANGED PLATE.—As pointed out in a previous issue, this part may easily be constructed from a 2½" × 2½" Flat Plate and two 2½" Angle Girders. Its introduction, therefore, would tend to complicate the system unnecessarily. (*Reply to Bernard Partridge, Thornton Heath*).

CURVED ANGLE GIRDERS.—We regret the adaptability of curved Angle Girders is not sufficient to warrant their introduction. (*Reply to B. Lang, Doncaster*).

NEW EYE PIECE.—We have experienced no demand for an Eye Piece shaped to receive a Meccano Angle Girder instead of an ordinary strip, and we think that the uses of such a part would be very limited. (*Reply to George Cowell, Preston*).

A MECCANO PELTON WHEEL



This very original model secured an award for Lindsay Mair, of Khandallah, Wellington, in the 1926 New Zealand Model-building Competition, a report of which appeared in last month's "*M.M.*"

It will be observed that the wheel is constructed from a series of 2½" Curved Strips connected to the hub (a Bush Wheel) by 2½" or 3" Strips. The buckets are represented by Angle Brackets bolted round the circumference of the wheel, and the "supply pipe" is composed of Angle Girders ending in a "nozzle" consisting of an Axle Rod secured in a Coupling.

The valve-operating wheel, by means of which the flow of water is regulated, is indicated by the 1" Pulley shown in the foreground.

RATCHET COUPLING.—Your suggestion for a ratchet unit, of somewhat similar design to the Dog Clutch, has been noted for careful consideration at a later date. (*Reply to George Bowdler, Kidderminster*).

IMPROVED 1" PULLEY WHEEL.—We note that you support the suggestion regarding the introduction of larger holes in the 1" loose Pulleys so that Meccano bolts may be passed through them. We find there are several difficulties to be overcome in order to adopt this suggestion, but we shall keep it in mind. (*Reply to Henry Fagg, Milton, Otago, N.Z.*)

SEMICIRCULAR CONTRATE WHEELS.—In reply to your suggestion regarding the introduction of a semicircular Contrate Wheel, or a Contrate Wheel having teeth cut in one half of its circumference, we would refer you to our remarks on the above suggestion for a "One-sided Toothed Wheel." (*Reply to George Waters, Derby, and L. Johnstone, Blackhill, Co. Durham*).

CLUTCH.—We regret your proposed clutch unit is too elaborate to adopt at present. We have numerous schemes on hand, however, regarding different types of Meccano clutches and we hope to make an announcement concerning them in the near future. (*Reply to J. Dippy, Bexley*).

DOUBLE CONE PULLEY.—We are unable to discover any particular advantage that would accrue from the introduction of a double Cone Pulley. In the event of such a part being required, it would be quite simple to substitute two of the existing Cone Pulleys (Part No. 123). (*Reply to O. P. Dinnick, London, W.*)

BEVELLED DOG CLUTCHES.—We shall consider the suggestion that the teeth in the Dog Clutch should be bevelled slightly at their edges to facilitate their engagement when the clutch segments are brought together. (*Reply to George Bowdler, Kidderminster*).

SLOTTED STRIPS.—We shall look into the possibilities of your suggested Strip having a slot cut through the greater part of its length. (*Reply to C. N. Beattie, Lewes*).

CURVED PLATES.—We are interested in your proposals regarding the manufacture of curved plates so designed that three or four may be bolted together to form boilers, etc. Probably you will have noticed from previous issues that the question of tubular elements, such as cylinders, boilers, gun barrels, etc., is receiving our constant attention. (*Reply to J. C. Lenthall, Diss, Norfolk*).

CARDBOARD ACCESSORIES.—We do not favour the introduction of cardboard sheets printed in colours to represent doors, windows, etc., as these would lack the strength and realism of the present Meccano system. We agree that such accessories might improve the appearance of certain models, but we think Meccano boys would prefer in these cases to manufacture the cardboard pieces for themselves. (*Reply to G. E. Everist, West Croydon*).

NEW SPANNER.—We were very interested to receive the specimen of the new spanner that you have designed. This is undoubtedly a useful part, but its functions appear to be covered already by the existing Meccano Box Spanner (part No 34b, price 3d.), which is fitted at each end with a groove to receive the nuts and a hole through which the shank of the bolt may pass. (*Reply to D. R. Mainwaring, Auckland, N.Z.*)

NUMBER PLATES.—Your suggestion regarding the manufacture of miniature number plates for model motor cars is interesting, but these parts would not serve any really useful purpose. We may mention that realistic number plates may be punched out with the name-stamping machines found on most station platforms. (*Reply to G. L. Wilson, Melton Mowbray*).

BENDING MECCANO STRIPS.—We note your remarks concerning the introduction of permanently curved strips for use in the construction of arches, etc. This innovation would complicate the system to a great extent, however, and there are now comparatively few models in which some of the existing curved parts cannot be used to avoid bending the ordinary strips. If you are unable to straighten properly any part after bending, a good plan is to place it on a hard flat surface, such as a slab of stone or iron, and tap smartly but gently with a hammer until the part is returned to its normal condition. (*Reply to Frank J. Harris, Bridgend, Glam.*)

IMPROVED FLANGED PLATES.—We consider that if elongated holes were substituted for the present round holes in the flanges of Parts No. 52 and 52a, etc., these Plates would lose many important attributes. (*Reply to S. Riley, Stowmarket*).

BRASS RACK STRIPS.—A brass Rack Strip would not be more efficient than the existing steel part. On the other hand its cost of production would be much greater and therefore its introduction cannot be recommended. (*Reply to L. Hollyoak, Earlsdon, Coventry*).

IMPROVED LOADED HOOKS.—Your suggestion that the small connecting links attached to the Loaded Hooks should be extended, so that they may be bolted between two Strips, is interesting, and will receive further attention. (*Reply to G. H. Wallis, Hull*).

Suggested Hornby Train Improvements

MODEL GASOMETER.—Your suggestion is very interesting but there would be little demand for a miniature gasometer. Although this accessory would look well if used in conjunction with very large layouts, it would serve no really useful purpose. (*Reply to H. W. Jacomb, Godalming*).

MINIATURE MERCHANDISE.—We note your suggestions regarding the introduction of small crates, barrels, and packing cases, etc., for use in connection with the goods trains. Such accessories may very easily be manufactured at home, however, from pieces of thin wood or cardboard. The Meccano Miniature Loaded Sacks (Part No. 122) will also be found very useful for loading Hornby trucks. (*Reply to H. M. MacFarlane, Plymouth*).

ALTERATION TO GUARD'S VAN.—We shall consider your proposal concerning the removal of the central post in the double doors of the Guard's Van, to permit easier access to the interior of the van. (*Reply to Leonard Marson, Bexhill*).

LIGHTING THE STATION.—The addition to the Hornby Station of a holder for a small electric bulb would increase the cost of the station, and not every Hornby enthusiast requires to light his station electrically. On the other hand, it is a simple matter to fit one or two Meccano lamp holders in the interior of the station if desired. We shall consider your suggestion to the effect that the roof of the station should be mounted on hinges. (*Reply to K. E. Boone, Sherborne*).

NUMBERS ON LOCOS.—We note your remarks re the provision of three or more different numbers for each class of loco, but we fear this would complicate matters considerably, and would also increase the cost of manufacture. (*Reply to W. R. Tomkins, London, S.W.16*).

NEW STATIONS.—We are giving careful consideration to your suggestions regarding new and improved stations and shall deal with them more fully at a later date. (*Reply to W. R. Tomkins, London, S.W.16*).

ELECTRICAL LEVEL CROSSING.—We are interested in your suggestion concerning the introduction of a Level Crossing fitted at each end with a small section of "live" rail, the sections being connected electrically by an insulated wire passing beneath the Crossing. When we stated in the November 1926 "*M.M.*" that the impetus of the train must be relied upon to carry it over a Level Crossing in an electrical track, it was taken for granted that the ends of the conductor rails on each side of the crossing would be connected by a wire, and since it is quite a simple matter to effect this connection we doubt whether it would be worth our while to introduce the special accessory that you describe. (*Reply to J. W. Ball, Rickmansworth*).

TRAINS IN OLD COLOURS.—We do not think it would be advisable to supply trains in the colours prevailing prior to the amalgamations. They would be far behind the times and for that reason would not be at all popular with Hornby enthusiasts. (*Reply to L. Shome, Wigan*).

3 ft.-RADIUS RAILS.—We note your suggestions regarding the introduction of curved rails to form circles of 6 ft. diameter. An objection, however, lies in the fact that many Hornby enthusiasts are not in a position to devote to their railway the amount of space that would be required by a layout using curved rails of this size. (*Reply to Masoa Yoshida, Tokio, Japan, and S. W. J. Keddle, Parkstone*).

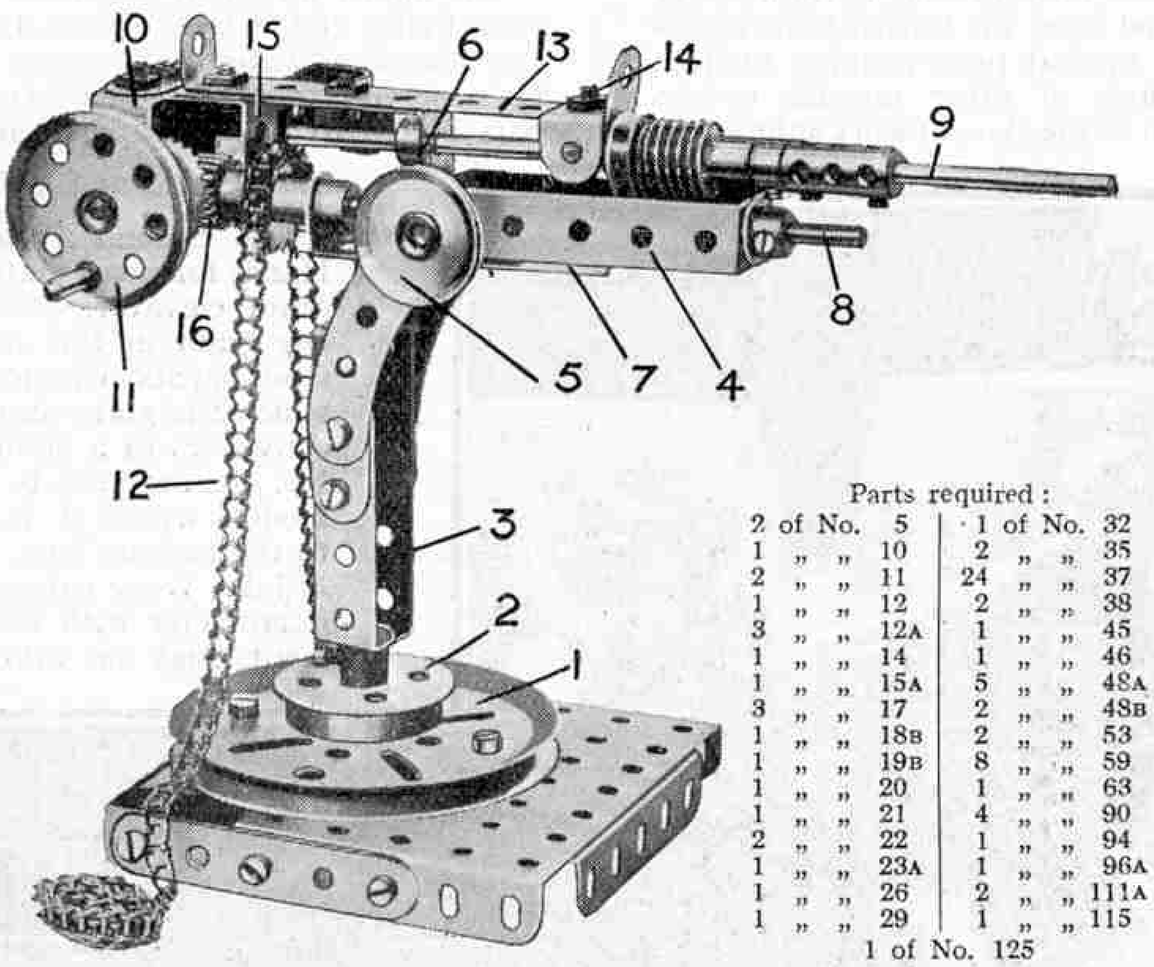
DEFECTIVE GOVERNOR.—It seems to us that the governor on your Hornby engine has become defective. It should control the speed of the engine to ensure it keeping to the track without load. (*Reply to G. Thompson, Bradford*).

SPEED CONTROLLER.—We fear that the space in our locos is rather too confined for the fitting of a speed controller, although possibly something on the lines of a gramophone controller might be feasible on the larger type. (*Reply to R. S. Williamson, Swansea*).

RAIL MOTOR TRAIN.—We doubt whether a rail motor train of the type used by some Railway Companies for light local services would prove a popular addition to the Hornby System. (*Reply to C. A. Surrey, Guildford*).

OVERHEAD WIRE FOR ELECTRIC TRAINS.—As explained in the "*M.M.*" for February 1926, it would be a costly matter to adapt the Hornby Electric Trains to run from an overhead wire on account of the extra gear necessary—such as the trolley, or pantograph, and wayside standards, etc. The alteration would also make the preparation of layouts a more difficult and lengthy process. We are unable to agree that this alteration would facilitate the conversion of ordinary Hornby Trains to electrical working, for an electric motor would still have to be substituted for the clockwork mechanism of the engine, and the cost of the standards, etc., would probably equal that of the electrical rails. (*Reply to Ronald Brotherton, Grimscar, Huddersfield*).

A NEW NAVAL QUICK-FIRING GUN



Parts required :

2	of No.	5	1	of No.	32
1	" "	10	2	" "	35
2	" "	11	24	" "	37
1	" "	12	2	" "	38
3	" "	12A	1	" "	45
1	" "	14	1	" "	46
1	" "	15A	5	" "	48A
3	" "	17	2	" "	48B
1	" "	18B	2	" "	53
1	" "	19B	8	" "	59
1	" "	20	1	" "	63
1	" "	21	4	" "	90
2	" "	22	1	" "	94
1	" "	23A	1	" "	96A
1	" "	26	2	" "	111A
1	" "	29	1	" "	115
			1	of No.	125

We illustrate the realistic model with which Raymond Stokes, of Stanley, Liverpool, obtained Second Prize in the 1926 "No. 4 Outfit" Model-building Competition.

The vertical 4½" Rod forming the axis about which the gun pivots is free to turn in the boss of the 3" Pulley Wheel 1 and is held in place by a Flanged Wheel 2 and a 1" Pulley Wheel beneath the wheel 1. Two Double Angle Strips 3, spaced apart by a Double Bracket, are mounted upon this vertical Rod and held in place by a Collar secured to its upper end. Two 2½" Curved Strips overlapped four holes are bolted to each of the Double Angle Strips 3, and their upper holes form bearings for a short Rod passing through the ends of further Double Angle Strips 4 and carrying a hand wheel 5. Two Spring Clips are mounted on the Rod inside the Strips 4 to secure it to the pivoting portion of the gun, the elevation of which may be altered on turning the wheel 5.

The Strips 4 are bolted to the end of a 2½"×1" Double Angle Strip 6 and the same bolt secures an Angle Bracket, which, in turn, is bolted to the 2½"×½" Double Angle Strip 7. The Rod 8 passes through the end holes of the Strips 4 and 7 and is held in place by two Collars. On the top of the Strip 6 is bolted a 3½" Double Angle Strip 13, the upturned ends of which form the sighting apertures. The bolt 14 secures a Double Bracket and an Angle Bracket, the latter, together with one of the holes in the Strip 6, forming bearings for the barrel 9.

A 1" Angle Bracket 15, bolted beneath the Strip 6, and the end of the Strip 7 provide bearings for the short Rod carrying a ¾" Sprocket Wheel and ½" Pinion 16. Two 1"×1" Angle Brackets 10 form bearings for a 2" Rod carrying the hand wheel 11. This Rod is fitted with a ¾" Contrate Wheel which engages with the Pinion 16. On rotation of the wheel 11, the small Sprocket Wheel actuates the Sprocket Chain 12, which represents the cartridge belt.

No. 2 STOCK FOR SMALL RADIUS RAILS.—We note your suggestions regarding various alterations to the Trolley Wagons and other "No. 2" rolling stock so that they may be used on 1 ft. radius curves. These alterations would spoil the design of the vehicles, however, and we think most Hornby enthusiasts would prefer to adapt their track to suit the existing No. 2 rolling stock, rather than purchase special vehicles. If you have a quantity of 1 ft. radius curves that you wish to incorporate in a layout it is a good plan to use them in a small branch line or siding reserved for No. 1 Locos and rolling stock only. The main line would comprise curves of 2 ft. radius only, of course, and all types of Hornby rolling stock could be run over that portion of the layout. (*Reply to M. English, London, S.E.3*).

EXTENDED KEY-SHAFT FOR LOCOS.—We appreciate the points you raise in support of your suggestion re fitting a squared key-shaft on each side of a loco. You will understand, however, that the alteration would entail very great expense, and we doubt whether the resulting gain would be sufficient to warrant the outlay. (*Reply to J. W. Evans, London, W.6*).

LUMINOUS PAINT FOR LAMPS.—Your suggestion is novel, but the luminous paint would take effect only in complete darkness, and we do not think many Hornby enthusiasts would care to run their trains under such circumstances. (*Reply to Frank Crompton, Esquimalt, B.C.*)

GAUGE 1 TRACK.—It is not our intention to produce Gauge 1 track at the moment, as the small demand for this size does not justify the manufacturing outlay. (*Reply to A. Simpson, Bury*).

IMPROVED METROPOLITAN LOCOS.—We fear the addition to the electric Metropolitan loco of two four-wheeled bogies and the provision of a flexible drive to one axle would increase the cost of the loco very greatly, without materially improving its efficiency. (*Reply to Ralph Brown, Foxrock, Co. Dublin*).

OUTSIDE CYLINDERS FOR TANK LOCOS.—A similar objection to that raised against the above suggestion (re "Improved Metropolitan Locos") applies also to your proposal regarding the addition of outside cylinders to the No. 2 Tank loco. We believe that, as a rule, the cylinders of an actual 4–4–4 tank engine are placed within the frames. (*Reply to G. E. Harrison, Glasnevin, and G. Trobridge, Johannesburg*).

ELECTRIC TURNTABLE.—We assume that you refer to a turntable fitted with a central "live" rail to enable it to be used in conjunction with electric trains; this suggestion is under consideration already. On the other hand, if it is an electrically-operated turntable that you have in mind, we regret that the cost of production of such an accessory would prohibit its addition to the system (*Reply to L. Hole, Bexhill-on-Sea*)

SOUTH AFRICAN-TYPE LOCO.—We are interested in your description of a South African-type freight engine, but we fear its introduction cannot be considered at present as the demand would be too small. (*Reply to J. E. Phelps, Johannesburg*).

SIGNAL ARMS.—Hornby Signal Arms may be purchased separately in either "home" or "distant" patterns, price 3d. each. (*Reply to G. L. Wilson, Melton Mowbray*).

GRADIENT INDICATORS.—We think there would be little demand for these accessories. (*Reply to W. Machill, Moss Side, Manchester, and E S. Milk, Hanworth, Manchester*)

ALTERATION TO SNOW PLOUGH.—We note your suggestion to the effect that the scoop and shield of the Hornby Snow Plough should be detachable to enable the wagon to be used when required as an ordinary covered goods vehicle. If we were to adopt this suggestion, however, it would be necessary to make the plough itself detachable, and we do not think the alteration is desirable. (*Reply to C. J. R. Boyce, Melton Mowbray*).

RAILWAY ACCESSORIES.—As you will see from our latest Hornby Book of Trains, practically all the accessories you mention have now been introduced into our system. We are considering the introduction of some of the remaining ones in the near future. (*Reply to G. Summers, Sydney, New South Wales, Australia*).

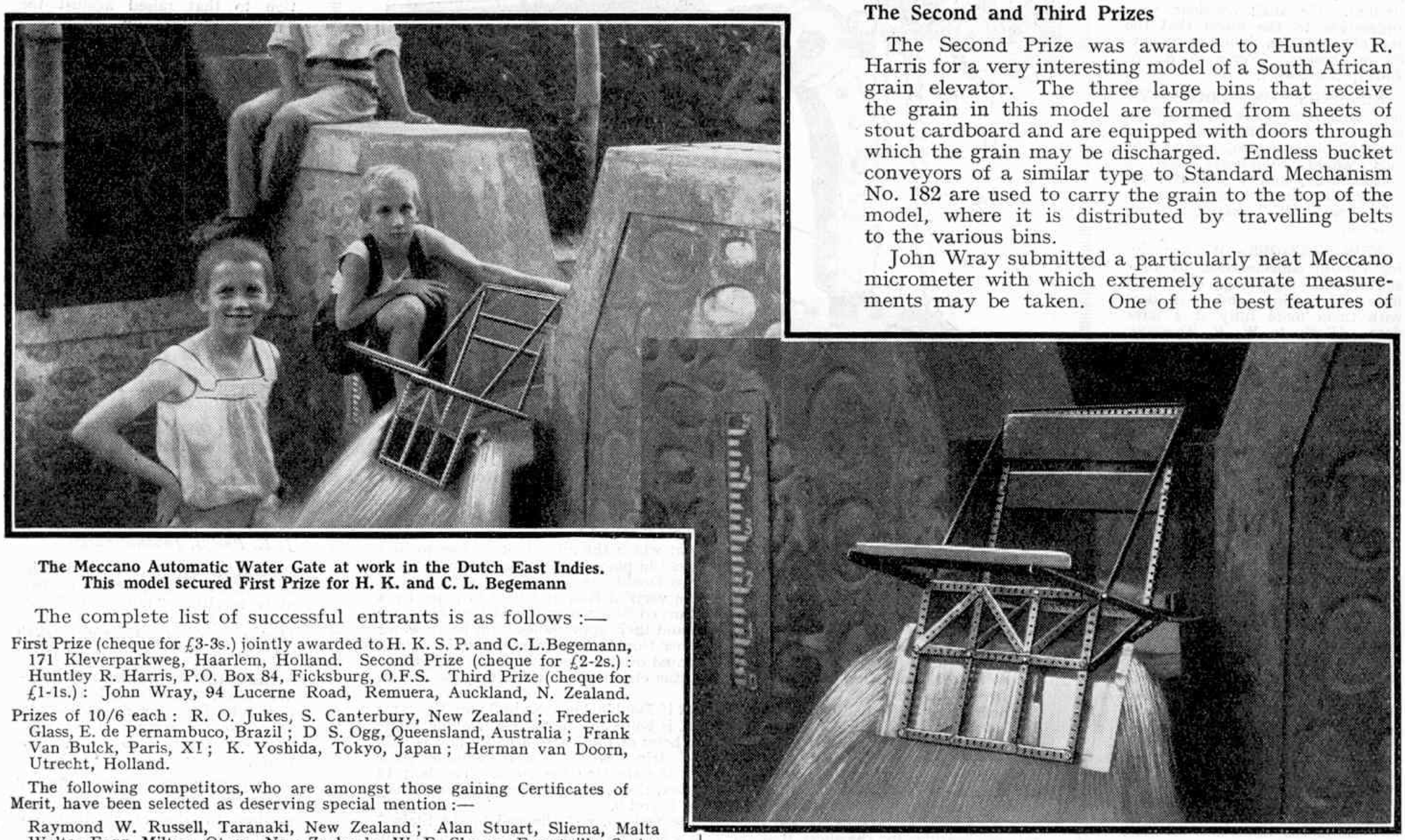
OIL STATION LAMPS.—Your suggestion for the introduction of oil-burning lamps has been made before by one or two readers, but we do not think that the illumination of the Hornby track and stations by this method would be an improvement on the use of electric lamps. (*Reply to S. Reid, Glasgow*).

Results of Meccano Model-Building Contests

By Frank Hornby

Overseas "Originality" Competition

IT will be remembered that the "Originality" Competition was announced with a view to testing our readers' skill in devising Meccano models of a novel character, or alternatively, models possessing unique adaptations of the standard Meccano parts. Our overseas readers responded to the test exceptionally well, and the majority of the models submitted in Section B of this contest are most interesting. Some idea of the extraordinary variety in the entries will be obtained from the illustrations reproduced herewith, which show three typical prize-winning models. The accompanying brief descriptions of other notable entries may serve also as a further indication of the class of work submitted.



The Meccano Automatic Water Gate at work in the Dutch East Indies. This model secured First Prize for H. K. and C. L. Begemann

The complete list of successful entrants is as follows :—

First Prize (cheque for £3-3s.) jointly awarded to H. K. S. P. and C. L. Begemann, 171 Kleverparkweg, Haarlem, Holland. Second Prize (cheque for £2-2s.) : Huntley R. Harris, P.O. Box 84, Ficksburg, O.F.S. Third Prize (cheque for £1-1s.) : John Wray, 94 Lucerne Road, Remuera, Auckland, N. Zealand.

Prizes of 10/6 each : R. O. Jukes, S. Canterbury, New Zealand ; Frederick Glass, E. de Pernambuco, Brazil ; D S. Ogg, Queensland, Australia ; Frank Van Bulck, Paris, XI ; K. Yoshida, Tokyo, Japan ; Herman van Doorn, Utrecht, Holland.

The following competitors, who are amongst those gaining Certificates of Merit, have been selected as deserving special mention :—

Raymond W. Russell, Taranaki, New Zealand ; Alan Stuart, Sliema, Malta Walter Fagg, Milton, Otago, New Zealand ; W. E. Cheary, Forestville, S. Australia ; William Isbister, Sydney, N.S.W. ; Billy Swift, Westmount, Montreal, Canada ; William Welsh, Ottawa, Canada ; J. W. Keiser, Haarlem, Holland ; C. O. Nanton, Port-of-Spain, Trinidad, B.W.I. ; S. Budge, St. Sampsons, Guernsey; Charles Hilder, Toronto, Canada ; P. Stoddart, Buenos Ayres, Argentina ; P. Renault, Paris ; J. Harrison, Cape Town, S.A.

Meccano Automatic Water Gate

The First Prize-winning model is the joint work of two brothers, and is of extremely simple design. It is in the form of an automatic water gate, and is of particular interest in view of the fact that the branch of engineering activity that it represents—Hydraulics—has not hitherto been dealt with in Meccano.

The gate is of a type first introduced about the year 1910, although the principle was invented by Mr. Doell, an engineer, as far back as 1887. It consists essentially of an arrangement of weighted levers placed about the axis of the gate in such a way that the latter is normally held closed. On the water rising above the full supply level, however, its volume overcomes the counterbalancing effect of the weights and opens the gate, thereby throwing out of centre a weight placed vertically above the axis of the gate. This weight now exerts a contra moment, which increases with the opening of the gate until the highest admissible flood level is reached, when the opening moment is equal to the closing moment and the gate offers no resistance to the flowing water.

The model was built by H. K. and C. L. Begemann while they were living in the Dutch East Indies, and the photograph shows the Meccano water gate amid realistic surroundings. It will be observed that the necessary weights are provided by iron bars bolted to the Meccano framework.

The Second and Third Prizes

The Second Prize was awarded to Huntley R. Harris for a very interesting model of a South African grain elevator. The three large bins that receive the grain in this model are formed from sheets of stout cardboard and are equipped with doors through which the grain may be discharged. Endless bucket conveyors of a similar type to Standard Mechanism No. 182 are used to carry the grain to the top of the model, where it is distributed by travelling belts to the various bins.

John Wray submitted a particularly neat Meccano micrometer with which extremely accurate measurements may be taken. One of the best features of this model consists of the provision of a small electric bulb, which lights immediately "contact" is made with the object to be measured. The various readings are indicated by dials, which show differences down to thousandths of an inch, and much ingenuity is shown by the methods adopted to obviate "play" in the bearings and between different parts of the model.

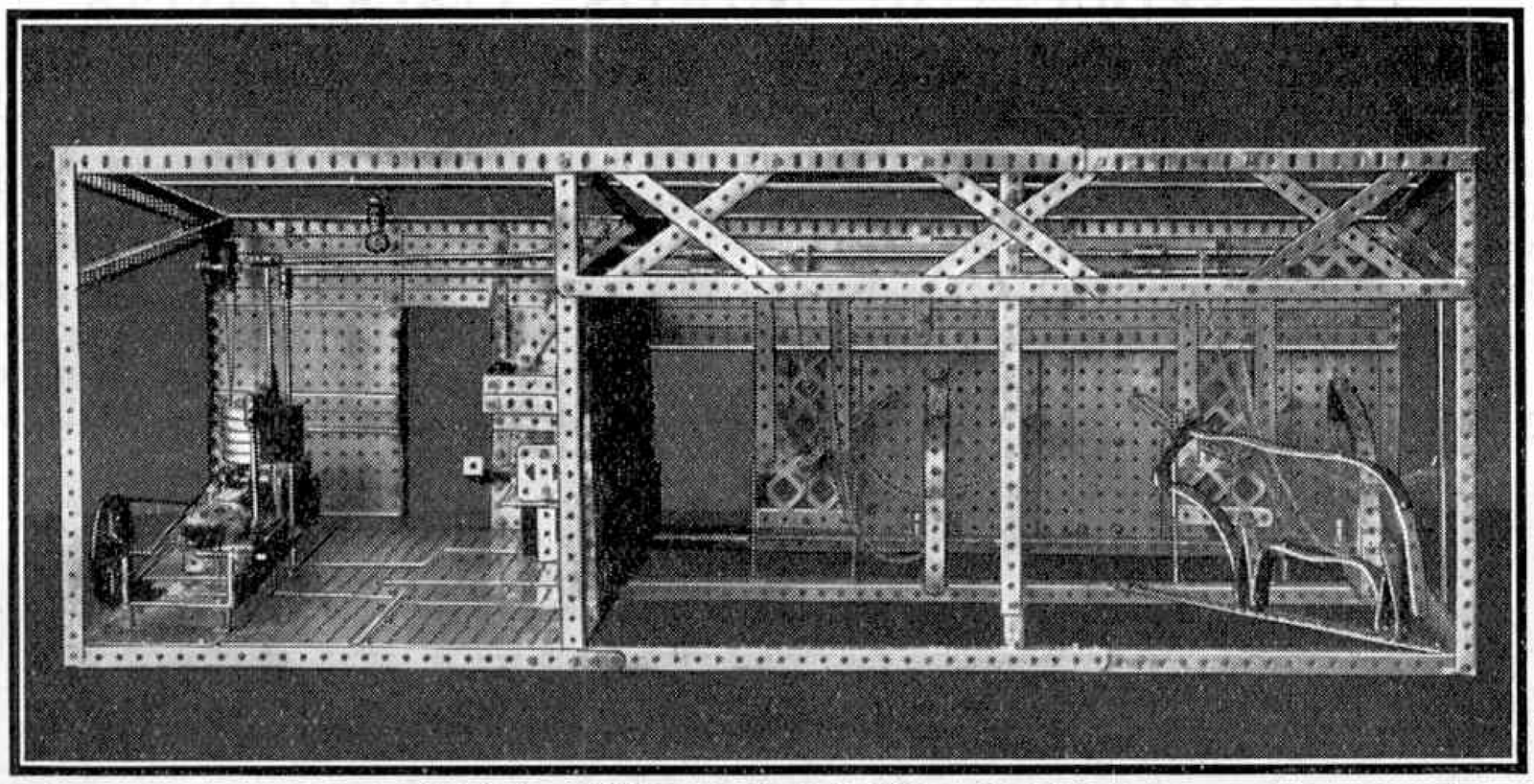
Farming Up-to-Date

A very fine model of "cow bails with milk-room" secured a prize for Robert O. Jukes. The model is illustrated herewith and it will be seen that it is not only complete with the very latest mechanical appliances known to dairy farming, but also contains a couple of cows ! It must be said, however, that the latter are not very robust in appearance, since they consist principally of a few Perforated Strips !

The cows are provided with teat-cups connected by means of plaited cord (representing rubber tubes) to the pipes (Axle Rods) leading to the separator in the milk-room. Lengths of

Sprocket Chain are placed round the cows while they are in the bails. The milk-room contains a vacuum pump and pulsator, with which the mechanical milking apparatus is operated; these are driven by a 4-volt Motor. A "vacuum tank," consisting of a number of Wheel Flanges, is fitted above the pump.

Other refinements of the model include Wearn's drive, with which a driving belt is kept tight automatically; milk vat; trough, consisting of an Angle Girder leading from the skimmed milk spout of the separator to a milk barrel placed outside the milk-room; releaser, etc., etc. The motor drives the separator by means of overhead belt gearing. The entire model is lit by electricity and forms an excellent demonstration of the advent of science to dairy-farming.



Cow Bails and Milk-room, by R. O. Jukes. (Cash Prize)

"King Angryface"

H. C. van Doorn sent in the very amusing model that forms the subject of our third illustration. He has named the awe-inspiring figure shown therein "King Angryface" and I certainly agree that this title suits the gentleman's expression very well! Readers will notice from the smaller photograph, or "close-up," that excellent use has been made of Propeller Blades and Curved Strips in designing His Majesty's unprepossessing features. I hope none of my readers will seize the opportunity afforded by a model of this description to deliver a severe shock to their sisters or younger brothers by suddenly confronting them with the spectre-like figure, which, incidentally, stands 5 ft. 6 ins. in height. I, for one, would not like to meet "King Angryface" in a dark corner unexpectedly!

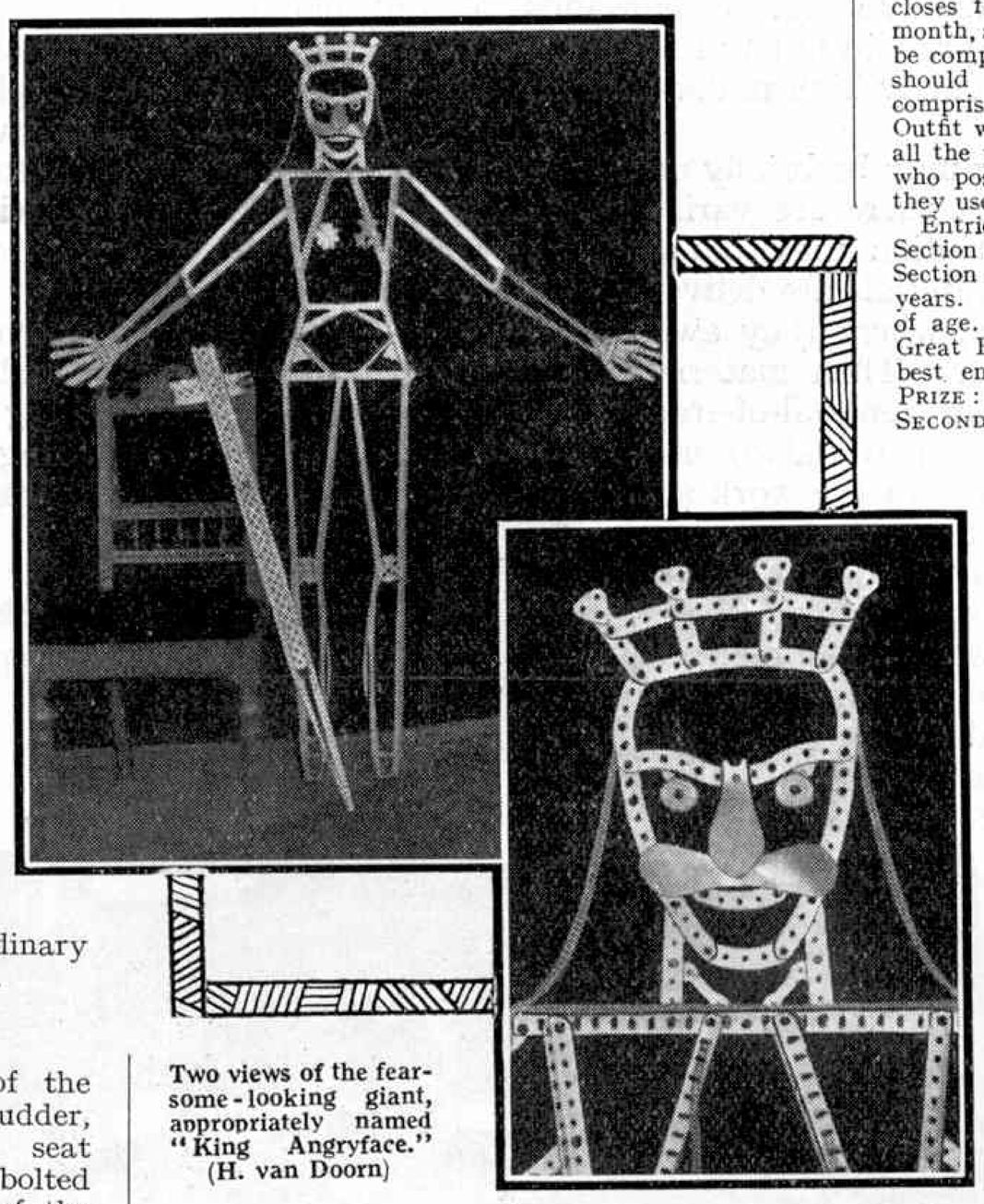
Frederick Glass submitted a most original model of a racing-skiff or skulling boat, complete with oars. The keel and hull of the boat are constructed from Angle Girders, and an excellent stream-line effect is obtained by the skilful use of a number of ordinary strips for the sides, bows, and stern.

Racing Skiff

The most interesting features of the model lie in the design of the seats, rudder, outriggers and oars. The cox's seat is formed from two Trunnions, bolted together and secured to the sides of the boat, but the oarman's seat consists of two Corner Brackets overlapped one hole, and bolted to two Eye Pieces sliding on a $5\frac{1}{2}$" Slotted Strip secured longitudinally in the hull of the boat. Each outrigger consists of a $5\frac{1}{2}$" and a $2\frac{1}{2}$" Strip extending outward from the side of the boat, their outer ends meeting and forming a support for the rowlock (a Double Bent Strip). The latter is secured in position by bolt and lock-nuts. The rudder is formed by an Architrave pivoted to a 1" Axle Rod by means of Flat Brackets and Collars, the latter being secured to the brackets by means of their set-screws. The oars are composed of $11\frac{1}{2}$" Axle Rods secured by Handrail Supports to Propeller Blades, which aptly represent the blades of the oars.

The model submitted by D. S. Ogg is in the form of a practical measuring machine that, if wheeled along by hand, will indicate in yards the distance travelled. The wheel that rests upon the ground and transmits motion to the indicating pointers is built up from eight Channel Segments secured to the boss (a Face Plate) by a series of Angle Girders. A $\frac{1}{2}$" Pinion on the axle of this wheel drives a $1\frac{1}{2}$" Contrate Wheel, and a Worm secured to the axle of the Contrate Wheel engages with a 57-teeth Gear Wheel. The pointer is secured directly to the shaft of the latter, and moves over a scale marked out to indicate the distance in yards. Further measurement is obtained by taking the drive from the pointer-shaft through a large reduction-gear, formed by Contrate gearing, etc., to a second pointer moving over another circular scale marked in multiples of the first and registering distances up to about three miles.

When it is required to return the pointers to zero they may be released by compressing a spring on the shaft of the first pointer, which normally holds the Gear Wheel in engagement with the Worm.



Two views of the fearsome-looking giant, appropriately named "King Angryface." (H. van Doorn)

A New "No. 1 Outfit" Model-Building Competition

In our last issue we offered prizes for the best models built entirely from Outfit No. 1. This competition closes for home readers at the end of the present month, and for overseas readers on 30th July. Would-be competitors who have not yet sent in their entries should do so, therefore, without delay. Models comprising parts that do not appear in the No. 1 Outfit will be disqualified. It is not necessary to use all the parts contained in the Outfit. Those readers who possess larger sets may compete, provided that they use only those parts contained in a No. 1 Outfit.

Entries will be divided into the following sections:—Section A, for competitors over 16 years of age. Section B, for competitors over 12 and under 16 years. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain. Prizes will be awarded for the three best entries from each Section as follows:—FIRST PRIZE: Meccano products to the value of £3-3s. SECOND PRIZE: Meccano products to value £2-2s. THIRD PRIZE: Meccano products to value £1-1s. SIX PRIZES each consisting of Meccano products to value 10/6.

Important Instructions

Actual models should not be sent. All that is required is a clear photograph or good drawing, together with any explanations thay may be desirable, although the latter should be made as brief as possible. The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition ("No. 1") and the Section in which the model is entered. Envelopes should be addressed "No. 1" Competition, Meccano Ltd., Binns Road, Liverpool.

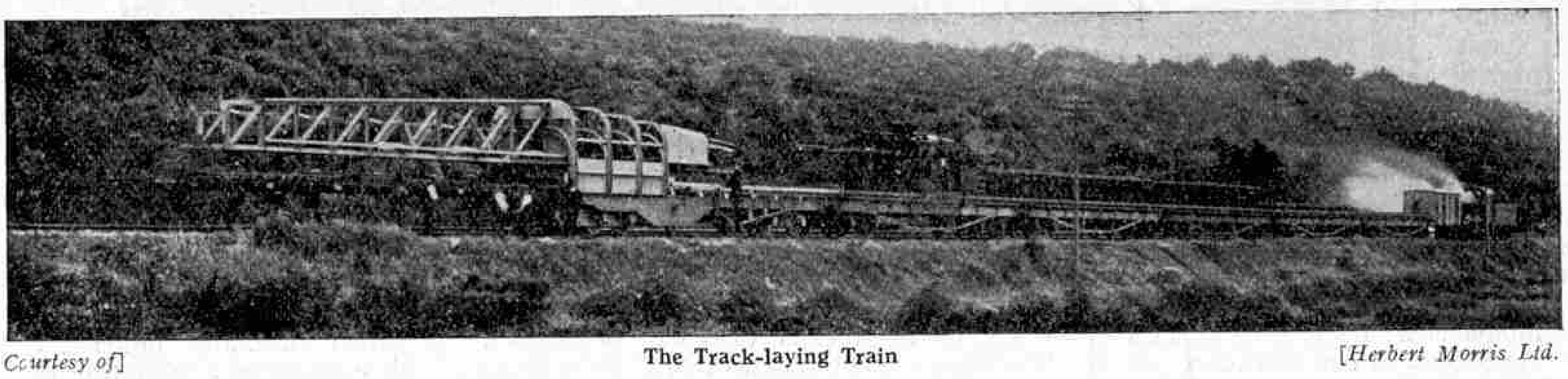
New Zealand (1927) Model-Building Competition

We wish to draw the attention of all readers who reside in New Zealand to the splendid competition that has been organised by Browning, Ifwersen Ltd., for 1927. Entries in this competition will be divided into several sections according to the ages of the competitors. Many handsome prizes, consisting of Meccano or Hornby Train goods to be chosen by the winners, are offered for entries showing particular merit. The contest is limited to New Zealand Meccano boys, and all entries must be received not later than 4.30 p.m. June 30th next. Would-be competitors may obtain their entry forms and all necessary particulars from their Meccano dealers or direct from Browning, Ifwersen Ltd., P.O. Box 129, Auckland, N.Z.

Re-laying Railway Track by Machine

The Wonderful Morris Track-Layers

IT is an extraordinary thing that there has been practically no change in the method of re-laying permanent way during the century that has passed since the first British railway was opened. It is true that the materials used have been greatly improved in quality and design, but although there has been an upward tendency in the weight of the materials used and in the length of rails—owing to ever-increasing axle loads—the original method of re-laying has not been materially improved upon to this day.



Courtesy of] The Track-laying Train [*Herbert Morris Ltd.*

Notwithstanding the employment in most cases of highly efficient material-trains and re-laying gangs, the method of handling individually so many thousands of separate units per track-mile re-laid must of necessity render the handling costs extremely high under modern labour conditions.

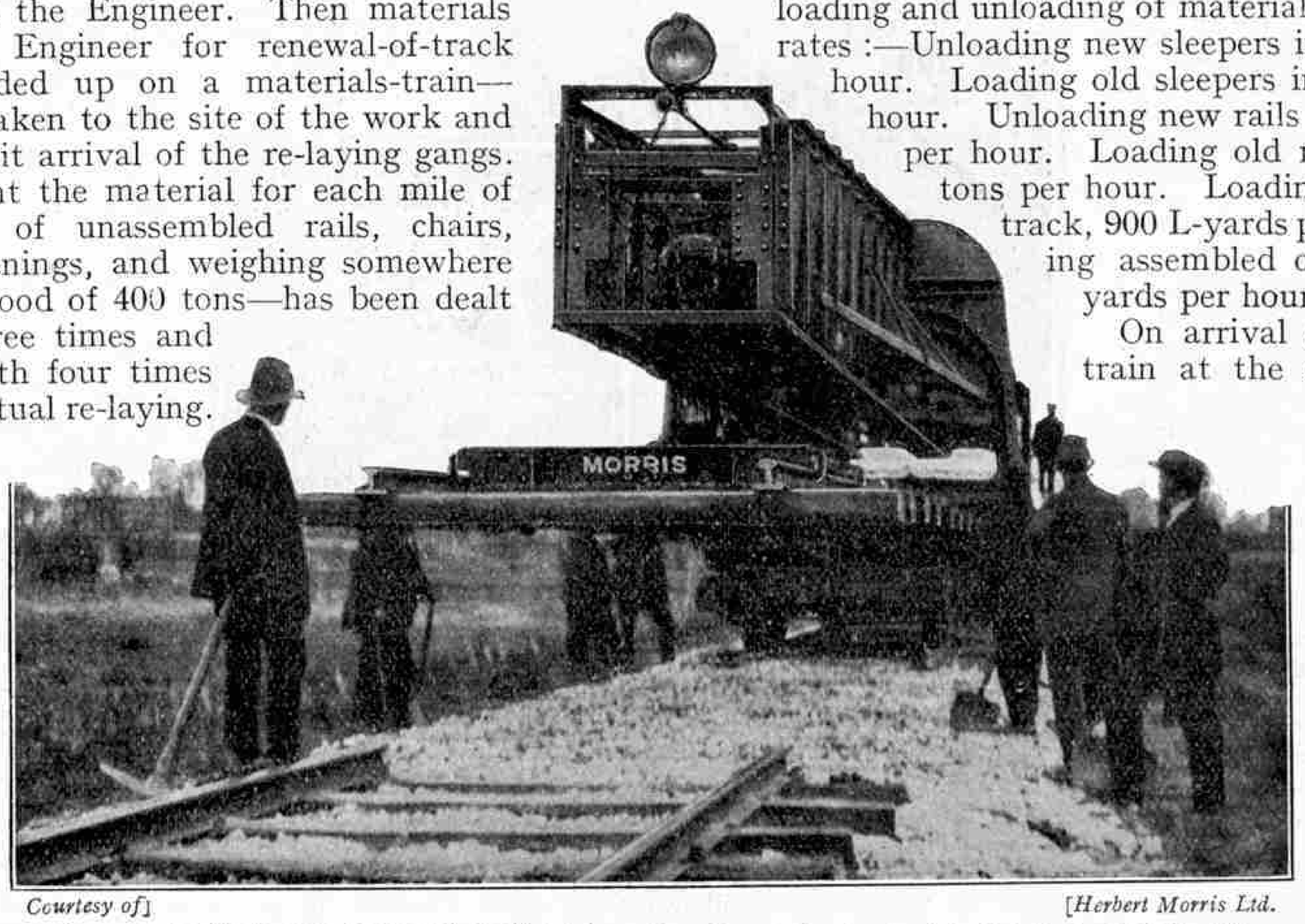
This old method of re-laying may be briefly described as follows, and while no doubt there are variations in some instances, yet the description may be taken as broadly typical. First, the materials are delivered and discharged by hand into Store, where they await the requisition of the Engineer. Then materials ordered by the Engineer for renewal-of-track purposes are loaded up on a materials-train—again by hand—taken to the site of the work and discharged to await arrival of the re-laying gangs.

Up to this point the material for each mile of track—consisting of unassembled rails, chairs, sleepers and fastenings, and weighing somewhere in the neighbourhood of 400 tons—has been dealt with by hand three times and must be dealt with four times in the course of actual re-laying. The old track is removed from the road by hand, loaded up in a wagon by hand, and discharged at the depôt by hand for distribution, for sale, or for re-use. Thus in order to re-lay any length of permanent way the new and old materials have to be transferred by hand no less than seven times in all, the total weight of the new and old materials being between 700 and 800 tons per mile.

These disadvantages are now overcome by the Morris Track-laying System, by which each mile of track is treated as so many units of assembled track, both as regards new track to be laid and old track to be taken up. For this purpose, and to eliminate as much work as possible on the site, a central depôt is arranged. This is equipped with a 15-ton (or higher capacity) electric overhead crane, so that all materials are loaded and unloaded in bulk by power and the assembling of the track is thus carried out under modern shop conditions.

All new track is assembled, with the assistance of crane power, in complete units, fully fastened, and loaded in bulk by power on the materials-train for laying at the site by the Track-layers. The old track in its assembled condition is dealt with in the reverse order on its arrival at the depôt. In regard to speed of working, it has been found in actual practice that a 15-ton capacity overhead crane will deal with the loading and unloading of materials at the following rates :—Unloading new sleepers in bulk, 1,500 per hour. Loading old sleepers in bulk, 1,500 per hour. Unloading new rails in bulk, 240 tons per hour. Loading old rails in bulk, 220 tons per hour. Loading assembled new track, 900 L-yards per hour. Unloading assembled old track, 800 L-yards per hour.

On arrival of the materials-train at the site of re-laying, the Track-layer is at once ready to come into operation for the purpose of unloading and laying the assembled units of new track, and simultaneously back-loading the still assembled units of old track on the same wagons. Our

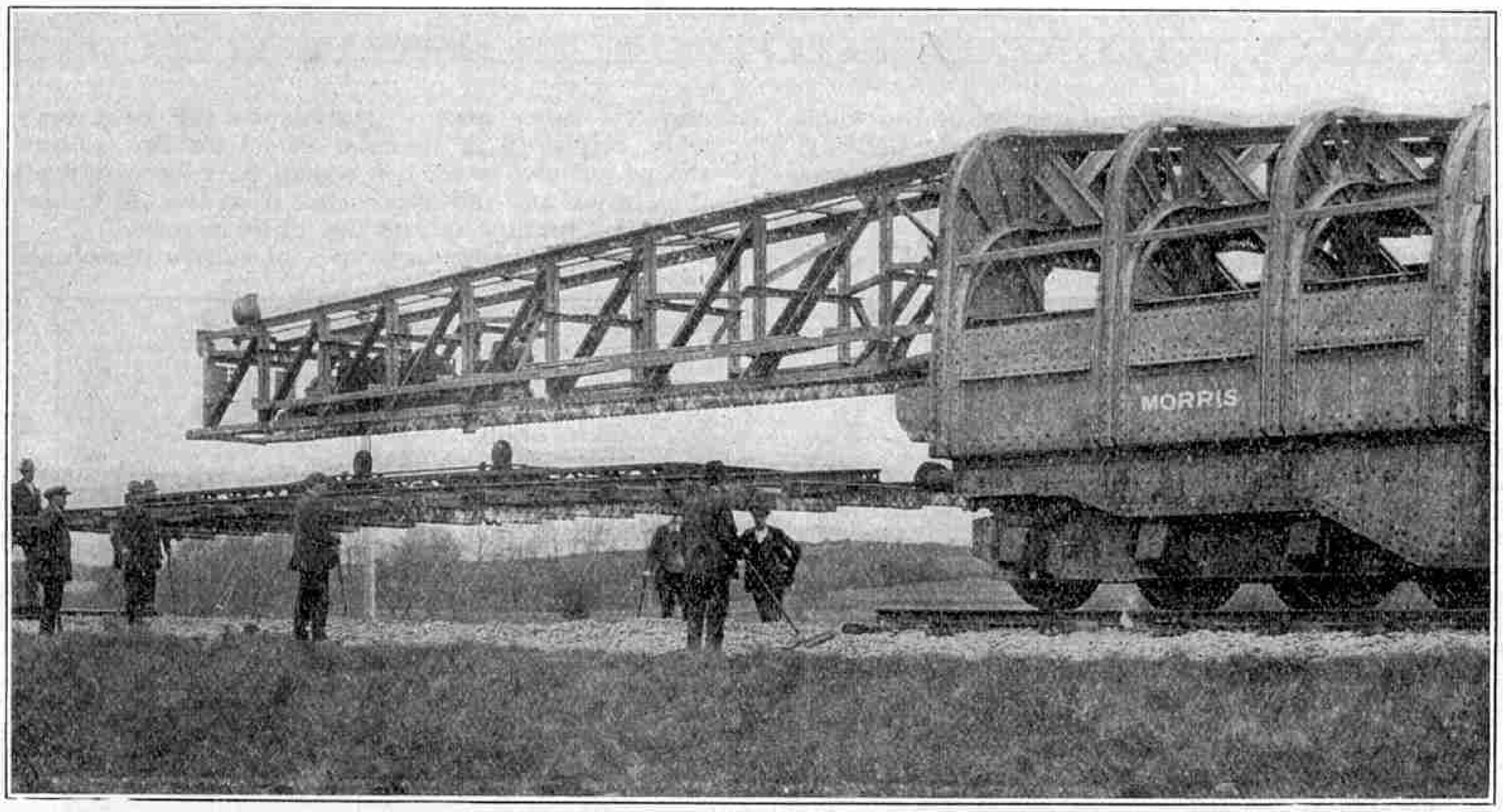


Courtesy of] [*Herbert Morris Ltd.*

One man is able to work faster with the Track-layer than the whole of a track-laying gang using the old method, even though the gang may be efficient and well drilled

first illustration gives a general idea of the make-up of the entire train when coupled to the Track-layer including the train-trolley and power van.

On account of the differing widths and heights of load-gauges existing in various parts of the world, alterations in the detail design of the train-trolley, trolley-rails and connecting links between the wagons are involved. The standard designs have been developed to permit of variation to suit the conditions of practically all railways. The train-trolley runs on rails bracketed from each side of the wagons, suitably hinged-sections providing the connection between the ends of the wagons, and compensating for curves and for the sway and relative movement between adjoining wagons. These hinged sections can be folded up out of the way for travelling or when the train is to be divided.



Courtesy of *Herbert Morris Ltd.*

The Cantilever Trolley picking up a length of old track to be loaded on to the train

A generating-set to supply electric power to the Track-layer and train-trolley, may be installed in the front brake van, immediately adjoining the locomotive. The electric supply is carried the full length of the train through protected conductor bars, one on each side of the trucks, with suitable flexible connectors between trucks. The power generally consists of a 50 h.p. high-speed steam-engine and dynamo, driven by steam direct from the boiler of the locomotive. This ensures reliable power and very effective electric lighting on a large scale so that re-laying work may be carried on at night. An alternative method is to employ an internal combustion engine for direct-driving the generator.

In practice, the only preliminary work carried out on the site, previous to actual re-laying, is the clearing out of the ballast between the old sleepers. When the train stops in the section at the point where re-laying is to commence, the crane trailer-truck and rear brake-van are uncoupled from the train, and re-laying operations commence immediately. The time taken from the stopping of the train in this section until the first length of old track is lifted by the crane does not exceed five minutes.

While the first section of completely assembled old track is being lifted by the Track-layer, the train-trolley has proceeded to the leading loaded truck. It has conveyed the first tier of assembled new track to the Track-layer, the interchange between old and new track taking place under the rear cantilever of the Track-layer.

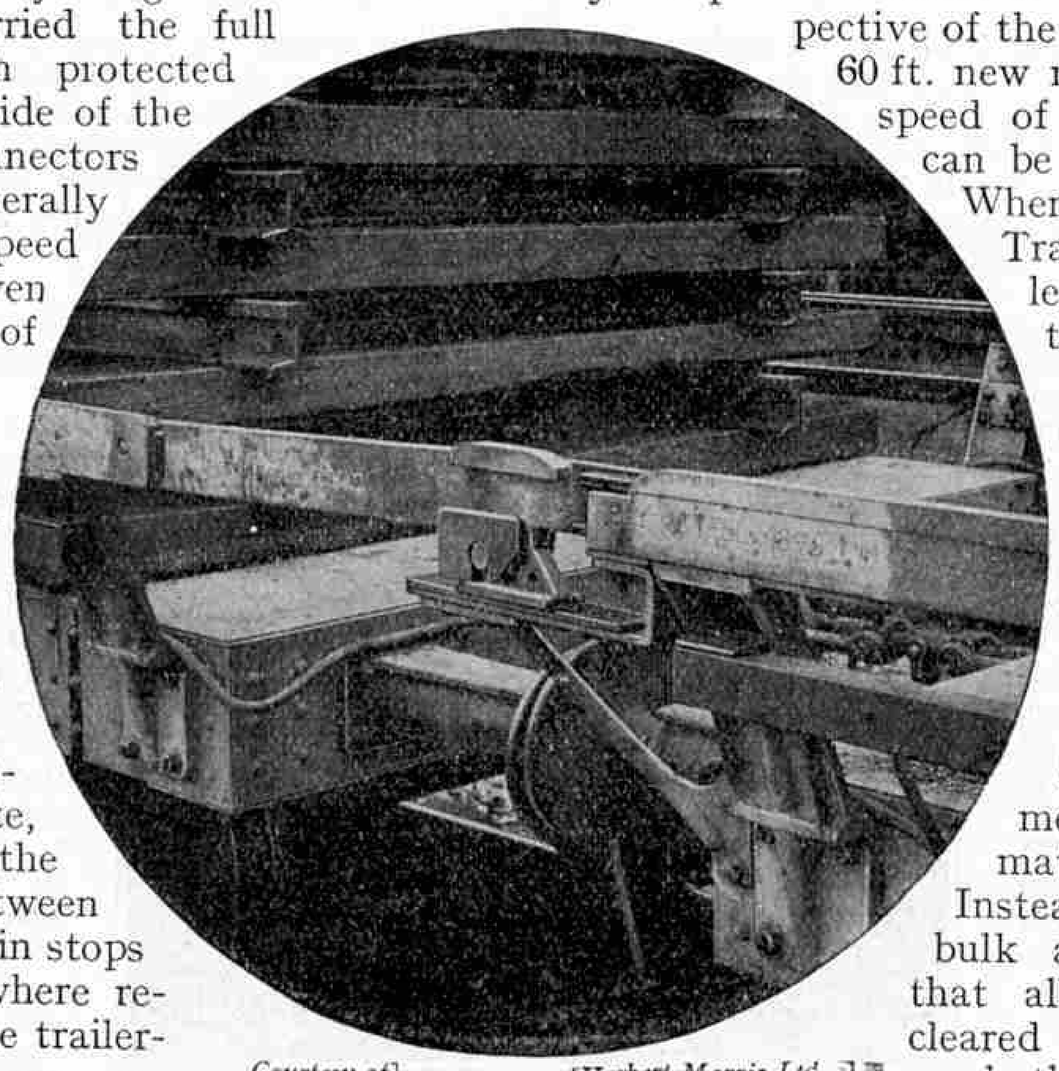
On the new section of track being lowered into place, the whole train moves forward one rail-length over the old track while the train-trolley at the same time deposits the old section of track on the loading wagon. This simple operation is repeated until all the new track has been laid and the train simultaneously back-loaded with the old track units.

The speed of re-laying is generally from 120 to 150 yards per hour where 45 ft. rails are being laid, and irrespective of the length of the old rails. Where 60 ft. new rails are being laid, however, a speed of 200 yards per hour or over can be obtained.

When the re-laying is completed the Track-layer and train-trolley are left in any convenient siding at the end of the section, and the materials-train returns to the depôt for unloading and re-loading. The time taken to unload and reload the materials-train, by the overhead electric crane, is about two hours and the train is then ready once more for despatch.

From the foregoing description it will be seen that by this new method it is not necessary for the materials to be dealt with by hand. Instead they are handled always in bulk and by electric power. Also that all the old material has been cleared off the ground and the only work that remains to be done at the site of the relaying

(*Continued on page 265*)



Courtesy of [*Herbert Morris Ltd.*

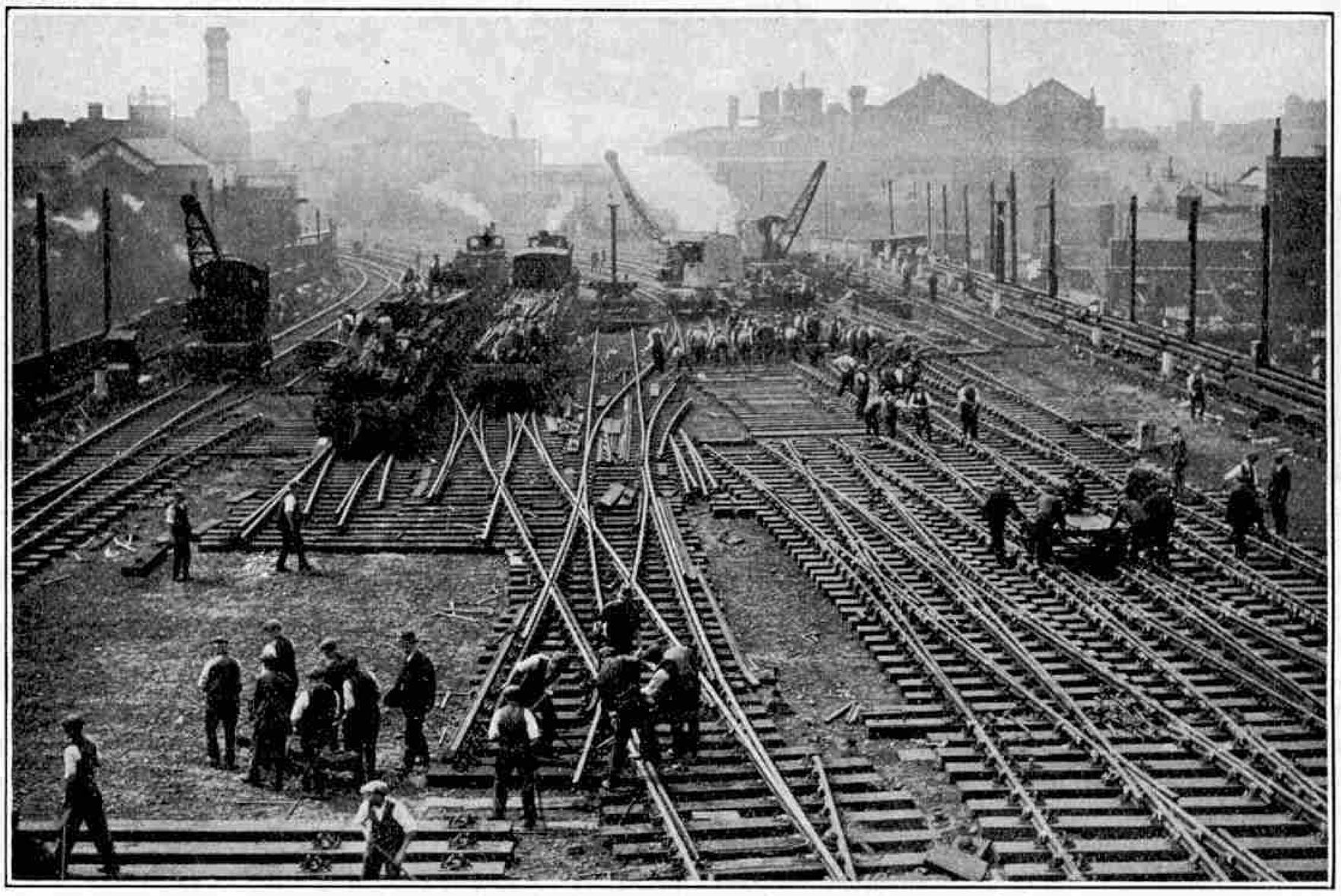
Showing the connecting link (in closed position) for the rail of the Train-trolley

Re-modelling a London Station

One of the Greatest Engineering Feats of Modern Times

ONE of the most important and intricate tasks of the whole of the electrification scheme of the Southern Railway, and one of the greatest engineering feats of modern times, was involved in the re-modelling of Cannon Street Station, which took place last summer.

To undertake this work the station was entirely closed, in accordance with the prearranged programme, from 3 p.m. on Saturday, 5th June until 4 a.m. Monday, 28th June. During these 22 days the Company's engineers took complete possession and effected a complete transformation of the whole of the network of the lines in the station and on the bridge. The platforms were remodelled, the signal box, which formerly spanned the full width of the bridge, dismantled, and a hundred-and-one other tasks performed. It is interesting to record that the whole of the work was carried out according to plan, and without the slightest hitch.



Looking towards London Bridge. The men at work removing old material and bringing in new

Some months beforehand the new track, destined for Cannon Street, had been laid out in a field alongside the goods yard adjoining New Cross Gate Station, in readiness for removal when the time came. A total length of approximately 1,000 ft. of lay-out was thus assembled complete to every detail including the fitting of point motors, electric conductor rails, signalling and power cables, etc. Here it was thoroughly tested, and every section indexed and numbered ready for taking up piecemeal for transportation to Cannon Street to replace the old track.

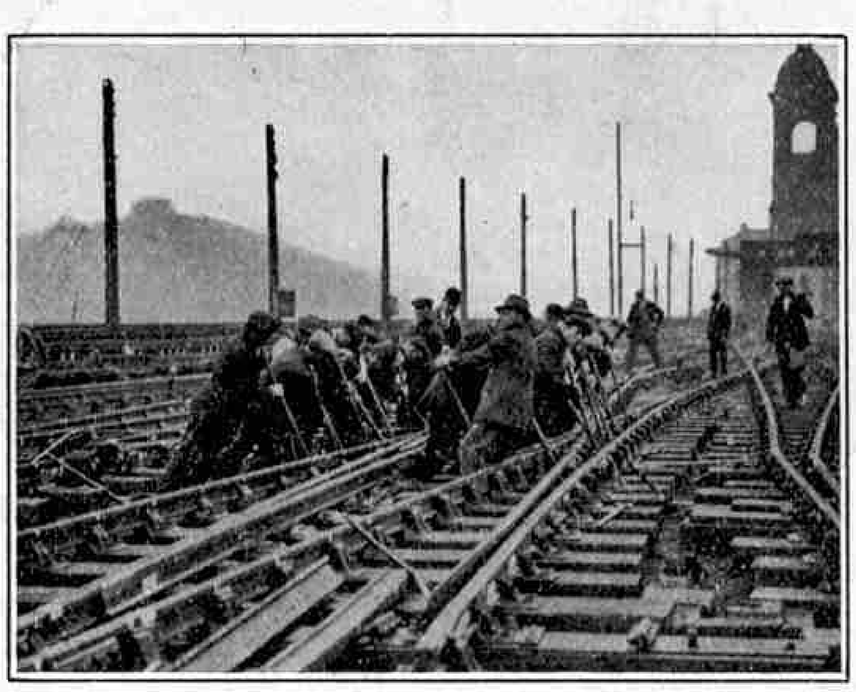
In connection with this latter task, an important point had to be reckoned with—that of metal expansion. Whereas the track was laid on cold earth in January, the new sections were going down on a metal bridge in warm weather. This meant that each section would expand to some extent. Over the whole bridge it was calculated for an expansion factor of 6 in. to be dealt with and this was allowed for section by section. Datum-line points were fixed all along the bridge, and the track and points were corrected for each section by triangulation as the work proceeded.

Five hundred permanent-way men and 250 other grades attached to the Engineer's Department were employed at Cannon Street on the alterations. During the period of transition it would have been difficult to recognise the station and rail approaches from the old Cannon Street with its trains running in and out every minute.

Rails were being torn up; platforms demolished; new lines were leading to nowhere; the great No. 1 signal box in dismantling looked a mass of scrap iron and scrap timber, As one spectator put it, the place in general resembled a war time railhead suffering badly from a dose of high explosive shells! However, the whole of the work was carried out to schedule, and on Monday, 28th June, the station, with its new running roads, remodelled platforms, and new signalling system, was re-opened without fuss or ceremony, to take its place as one of the chief termini of the greatest suburban electric system in the world.

It had long been recognised that Cannon Street Station was out-of-date, and in order to cope successfully with the ever-increasing suburban traffic brought by the electrification, very great alterations would have to be made to the running roads and platforms.

In the past, the lines were laid out to conform with the requirements of 50 years ago, bearing in mind particularly the old practice of reversing trains at Cannon Street, so as to serve that station and Charing Cross. Trains coming in from Charing Cross were able to cross on the bridge to a midway or eastern platform, and then leave again towards London Bridge more or less on the eastern side, while trains arriving from London Bridge were, as far as possible, crossed to a western platform to give them an approximately clear path for the continuation journey to Charing Cross. The discontinuance of this practice during recent years, and the systematisation of traffic associated with the method of "parallel" working, considerably simplified the difficulties in preparing the new lay-out.

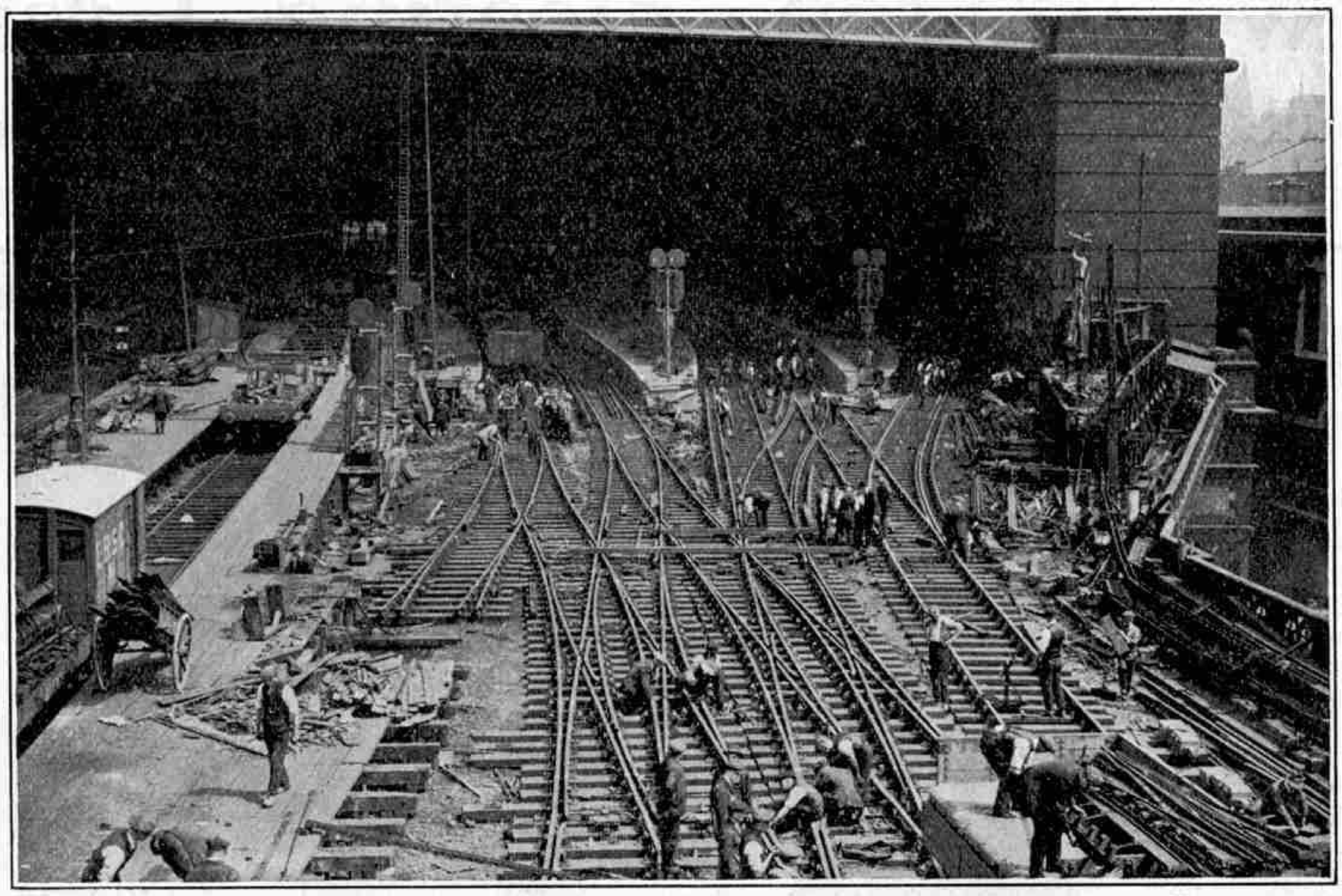


A gang at work, placing new lines into position

There are now four lines to and

from London Bridge—down, down, up, up—and with one exception (viz., up-local line to No. 1 Platform) all the platforms can be served from or to each of the in and out roads. The transfer of locomotives from the western side to Ewer Street or Charing Cross can be done on the western sidings without fouling the running lines.

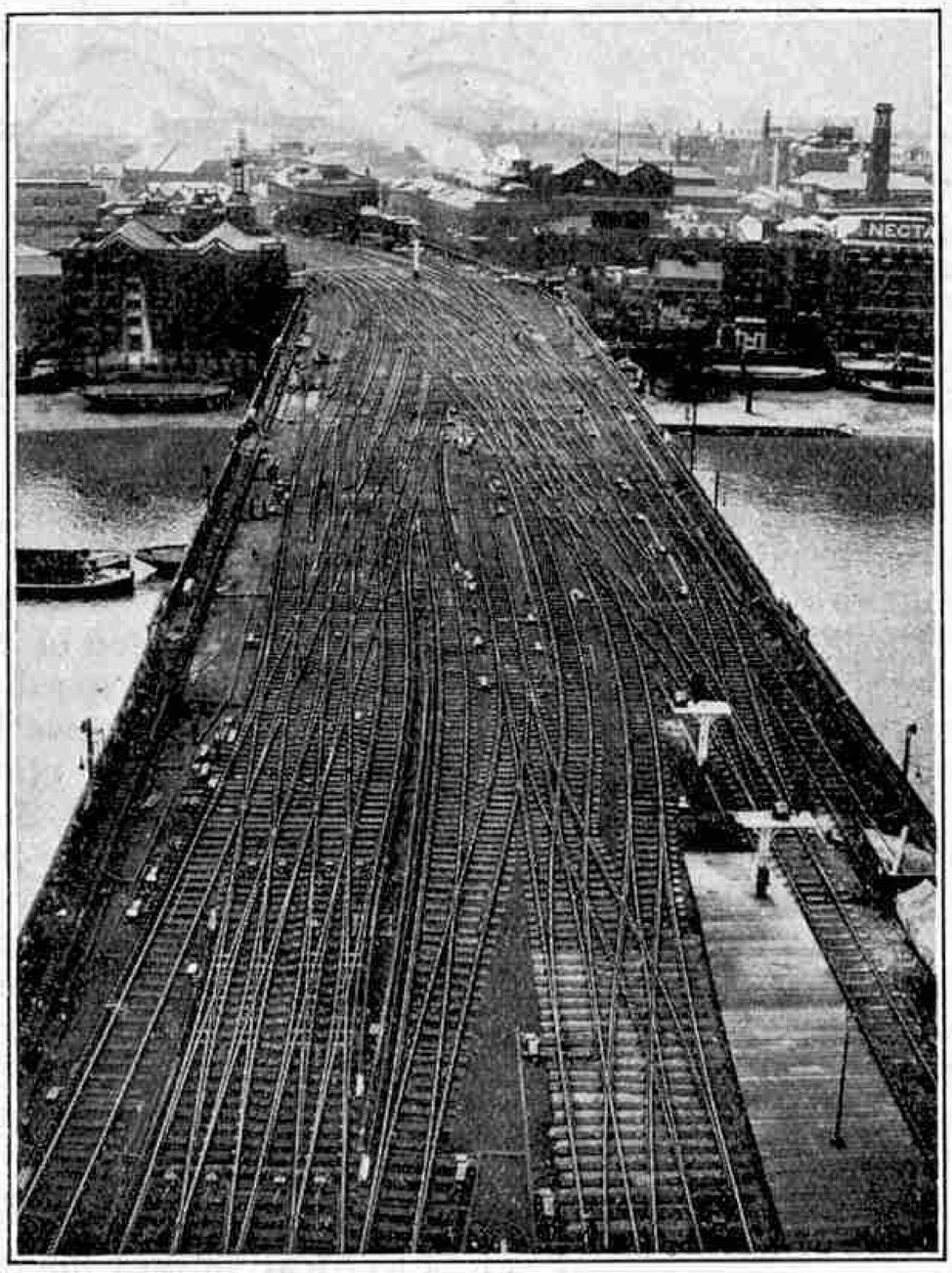
All four lines are equipped for electric traction, but the track routes towards Platforms 6, 7 and 8, when leaving those serving the other platforms, have not been laid with conductor rails. Towards Charing Cross two lines open out into three, joining the route from London Bridge to Charing Cross, these connections being available for the movements of engines and empty carriage trains, as has been the case for some time past. There are 77 sets of points in the whole of the new layout as against 101 in the old layout.



Photographs] **New Lines being laid and (on the left) one of the old platforms demolished** *[Courtesy S. Rly.*

The platforms at Cannon Street Station are now numbered from the eastwards (Nos. 1 to 8) instead of from the west as formerly, when there were nine platforms numbering 1 to 9. The old Platform No. 4, which was short, and could therefore only be used for trains of suitable length, is done away with. Platforms No. 1, 2, 3, 4 and 5, are used only for electric trains, No. 5 is also used for steam traffic, and Nos. 6, 7 and 8, for steam trains only. All the platforms have been widened and lengthened, none being less than 20 ft. in width. The lengths vary from 570 ft. to 748 ft.

In the old layout very little space was provided for light engine movements, and engines waiting to take out arriving trains often had to be held on a running line. Although, owing to the electrification, need for engine accommodation is now not so great and more room is available under the new layout. The situation is further improved by reason of the fact that formerly at the south end of the bridge it was necessary to provide engine accommodation on the western side only. The old engine shed on the eastern side, towards Borough Market Junction, was therefore done away with altogether, and its site used for a sub-station.



A photograph taken from the roof of Cannon Street Station, showing the new layout, looking towards London Bridge

The old elevated signal box (No. 1), which, spanning all the metals on the bridge, formerly controlled the traffic with the co-operation of the smaller No. 2 box, was removed, and there is now a new station signal cabin at the bridge end of No. 8 platform. This is power-operated, and much smaller and more convenient than the one it replaced. Instead of 332 manual levers to operate (245 in No. 1 Box and 87 in No. 2) there are now only 140.

The new electric light system was signalling brought into use in place of the former semaphore system. The principle of the signalling and electric power working of the points at Cannon Street and Charing Cross is now exactly the same as that of the installation between Holborn and Elephant and Castle but the apparatus is different and of an improved type.

The closing of Cannon Street naturally had the effect of throwing a large volume of passenger traffic upon London Bridge Station. Normally, London Bridge (eastern section) has 10,000 passengers and Cannon Street 22,000 from 7 a.m. to 10 a.m. Despite the Company's advice to passengers for the City to travel on to Charing Cross instead of overcrowding London Bridge, comparatively few did so, and London Bridge had an average of 26,000 "rush-hour" passengers to deal with every morning of the closing. As each incoming train emptied, the platforms became a mass of humanity anxious not to be delayed en route to business.

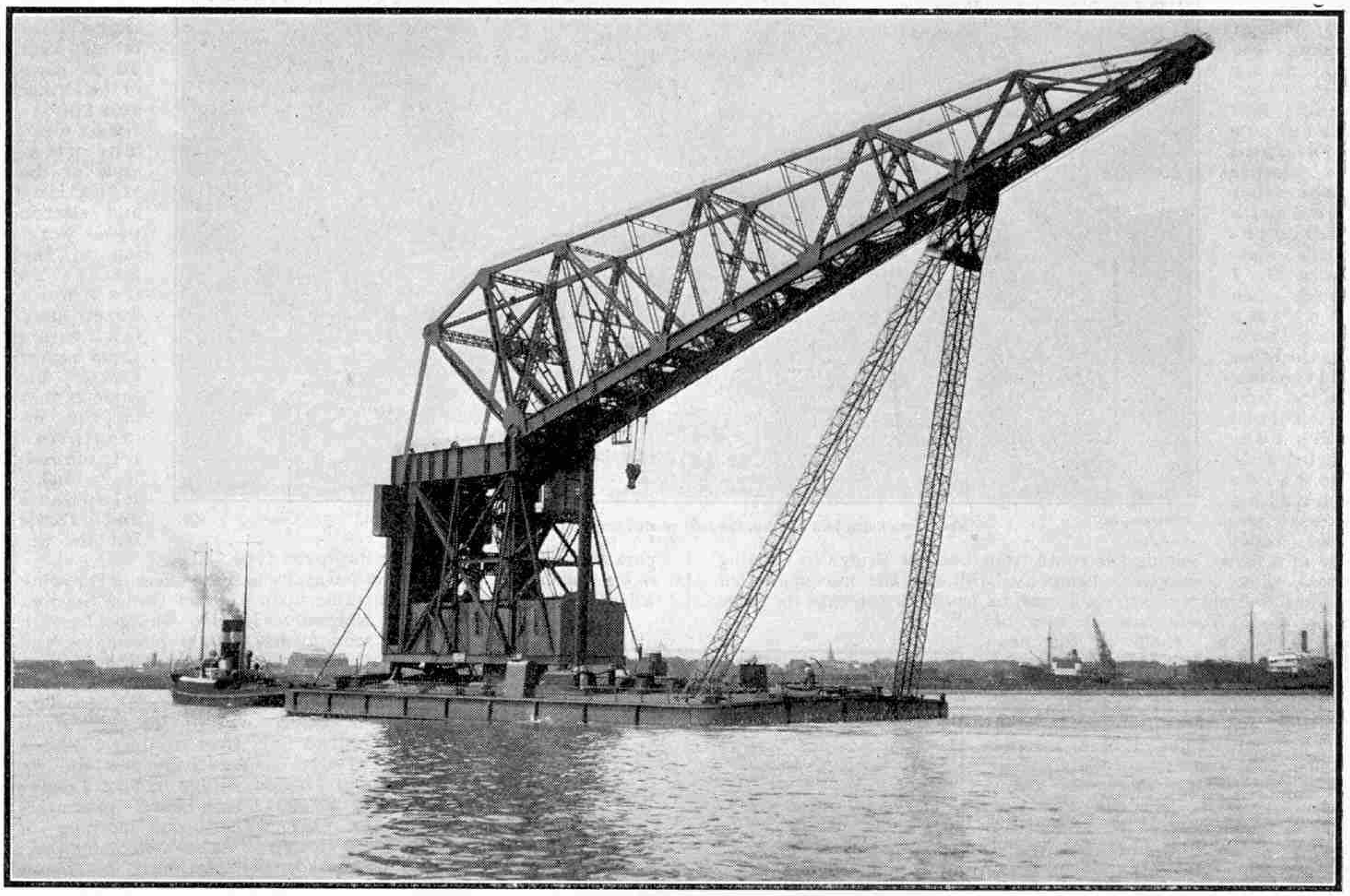
During the three hours mentioned, 81 train arrivals had to be dealt with at London Bridge (eastern section) daily; 23 terminated there, and 58 went on to Charing Cross. At the latter station also, it can readily be appreciated much extra work was entailed, over 6,000 extra passengers using this terminus every morning during the rush hours, the number of train arrivals per hour during this period being 26 instead of 15.

The preparatory work for the reconstruction was commenced as far back as January last year, when, as mentioned in the April "*M.M.*," a large girder measuring 140 ft. in length and weighing 72 tons was placed in position in the bridge over the river to permit the subsequent re-arrangement of the tracks. This smart engineering feat occupied less than 36 hours.

The manner in which the whole of the task in connection with the Cannon Street remodelling was schemed out and carried to a successful conclusion reflected the greatest credit on all concerned in the work.

New 200-ton Floating Crane

Built in Holland for the Harbour at Le Havre



THE fine floating crane illustrated above was delivered a short time ago to the Harbour authorities at Le Havre, that busy French port through which many troops and great quantities of munitions passed during the War.

The crane was built at Schiedam in Holland, by Werf Gusto, Firma A. F. Smulders, which firm it may be mentioned, built the "*Mammoth*," the 200-ton floating crane belonging to the Mersey Docks and Harbour Board and located at Liverpool.

The new 200-ton crane is of very similar design and appearance to the "*Mammoth*," which has already been described in these pages. It is able to hoist a load of 200 tons to a height of 160 ft. above the water-line at a distance of 95 ft. from the centre line of the crane. Alternatively, it is able to hoist a load of 150 tons at a distance of 130 ft. from the centre line of the crane.

Details of Crane Framework

The jib rests on the pivot bearing of a tower rigidly fixed to the deck of the pontoon.

There are two main blocks, each capable of handling a load up to 100 tons or when coupled together, will hoist a load of 200 tons. Two trolleys, capable of travelling along the whole of the crane-jib, also may be used either independently or coupled together. The hoisting speed of the two main blocks is 4.5 ft. per minute, and the speed of the trolleys 30 ft. per minute.

The crane framework may be divided into two sections (1) the lower platform, on which the winch-room is situated, and (2) the upper platform, on which the crane-jib is carried by means of two pins. Upper and lower platforms are connected by a strong steel structure. At the aft side of the tower are the screwed rods controlling the derricking movement of the crane-jib. Here also is the counterweight for balancing the jib.

On the lower platform are fitted the roller bearings on which the tower revolves. The crane can slew a complete circle in about six minutes.

Electrical Brakes make all Operations Safe

In the winch cabin are arranged the two 100-ton hoisting winches, the two 30-ton hoisting and travelling winches for the trolleys, and, in addition, the gear for

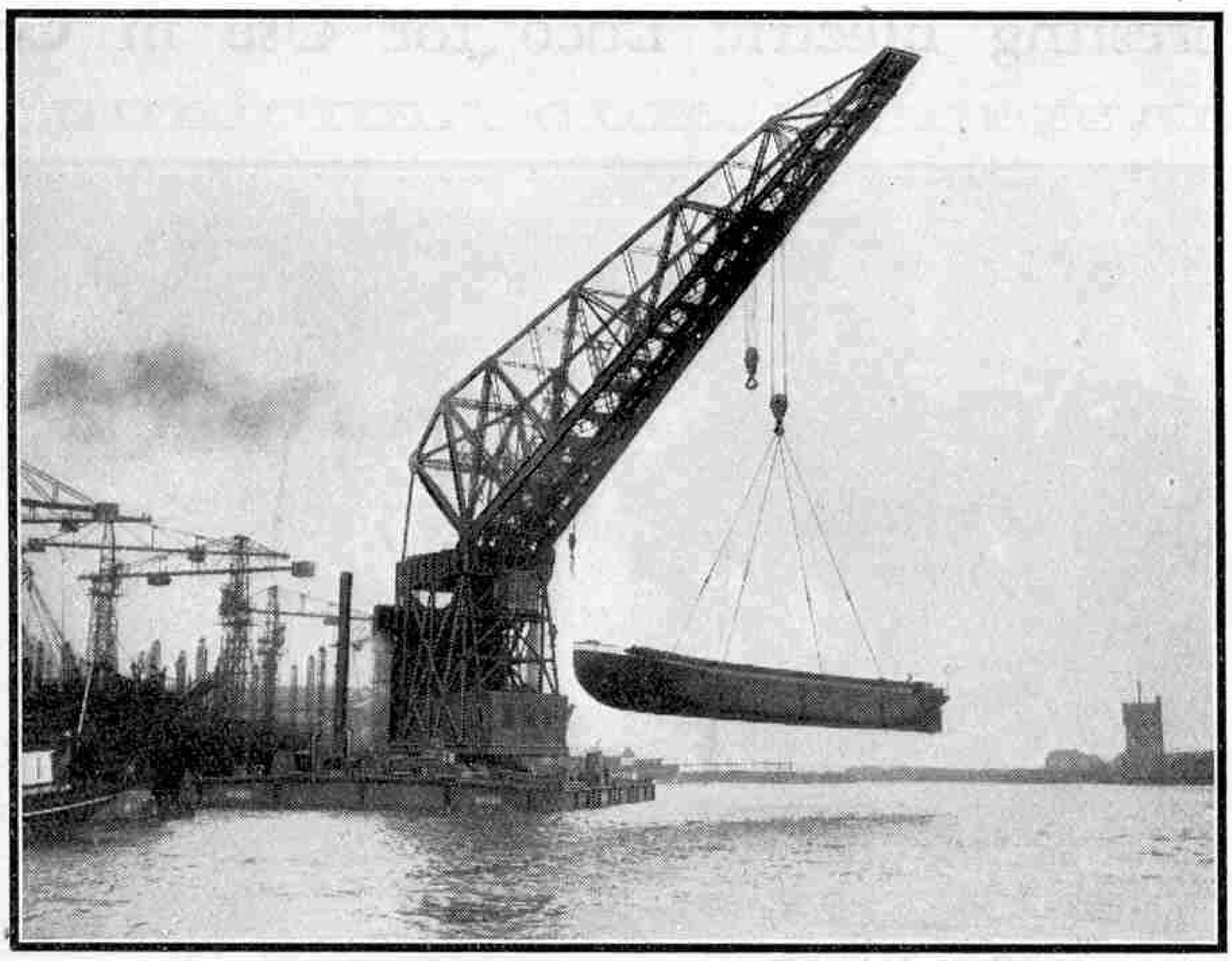
slewing and derricking.

All winches are provided with strong electrical brakes and all movements of the crane—such as lifting, derricking, slewing and travelling—are operated by the crane-driver from the cabin situated under the jib. From here the driver has an uninterrupted and clear view of all operations.

Only three men are required for operating the crane, viz. : engine driver, deck hand and crane driver, and the operating of the crane is extremely simple and absolutely safe. The loads can be dealt with with the greatest ease and security from the lowest speed imaginable to the highest speed admissible, without any change in the transmission gearing.

This is achieved by means of a special switching system, which has also other advantages, including :—(a) definite speed at a definite position of the controller ; (b) the regulation of very low current, and therefore scarcely any loss of energy ; (c) no interruption in the main current, and no wear of contacts and maintenance for the same reason ; (d) excellent safety devices and (e) no shocks and consequently no damage to the construction work.

The pontoon is divided into several watertight compartments and the after-deck is specially strengthened to carry loads of 200 tons. In the pontoon itself are the dynamos, driven by a triple expansion steam engine with surface condensers. Steam is supplied by a boiler with a working pressure of 147 lbs. per sq. in. This also supplies four steam capstans and one steam windlass. The pontoon, winch and driver's cabin are all provided with electric lighting from a separate steam dynamo. Cabins for officers and crew, galleys, lamp-rooms, lavatories, also coal-bunkers, water-tanks, stove-rooms, etc., are built on deck or in the pontoon.



Photos courtesy] [*Werf Gusto, Firma A. F. Smulders*

The new Crane picks up a heavy barge with ease

The crane was towed from Schiedam to Le Havre without the jib being dismounted, sheer-legs being fixed, as shown in the photograph on the preceding page, to make the crane sea-worthy. These sheer-legs were, of course, removed as soon as the voyage was completed.

Lives of Famous Inventors—

(*Continued from page 227*)

working model became a matter of immediate importance. There was no room in the already crowded workshop to carry out this work and therefore Watt rented an old cellar where he laboured on the construction of his model. Difficulties in plenty beset him, for he found that it was easier to plan than to erect. His sheer inventiveness gave him added trouble, for he was continually pausing in the work of construction while he sought to embody in the engine some new idea that had suddenly occurred to him. Thus was he often led into complications that proved of no practical benefit to the model and served only to hinder its completion the more.

Watt was unable to find workmen skilled enough to carry out his designs and the clumsy and often inaccurate handiwork of those upon whom he had to rely for the making of the cylinders and other large parts filled him with despair. As a result of this crude workmanship, when at length the engine was tried out many cracks and faulty joints were revealed by the steam, which openly hissed out of them, giving the model the appearance of some weird monster of evil ! When steam was drawn off and the condenser cocks shut, the piston ascended with the rapidity of a hammer-blow, in spite of a suspended burden of 18 lb. The descent of the piston when steam was again admitted into the cylinder was equally speedy.

Improvements in Spite of Difficulties

The roughly-made model thus more than justified its creation and Watt turned eagerly to the construction of a bigger and better one. There was not sufficient room for this to be built in the small cellar and a more commodious apartment was acquired in part of a building once used as a pottery factory. There, in company with an assistant mechanic named John Gardiner, the young inventor worked zealously on his new engine.

No mechanic who felt capable of boring out a cylinder could be found in the city, and Watt was dependent upon a metal worker or " whitesmith," who hammered this important part out of sheet iron, soldering it at the joints. The cylinder for the new engine admitted of a two-foot stroke of the piston and was about five inches in diameter. In order to keep the cylinder hot during the brief periods preceding each admission of steam Watt contrived a " steam jacket." The cylinder was inverted and enclosed in a casing of wood large enough to leave a cavity between its inner wall and the cylinder, this cavity being filled with steam when the engine was set to work. The piston was passed through an aperture in the bottom of the casing and thence through a steam-tight stuffing box, the packing in this being lubricated with oil.

At the end of two strenuous months the model was completed. Its success on trial was greatly marred, however, by the excessive leakage of steam through faulty joints and by bad workmanship generally, the numerous flaws in the cylinder detracting seriously from the value of the protecting steam jacket.

Vigilant Vanmen

Whilst a G.W.R. carman was making a delivery in Manchester recently, and whilst the vanguard had run forward to stop the horse, which had moved onwards, a parcel containing six dozen wristlet watches was stolen from the lorry. The vanguard noticed the theft and shouted to the carman, who immediately gave chase, leaving the horse and van in charge of a Midland Railway carman who was at the same premises.

The carman overtook the thief and knocked the stolen parcel out of his hand, which was recovered by the vanguard, whilst the carman endeavoured to close with the thief. The latter, however, succeeded in getting away after butting the carman in the face, smashing his artificial teeth and injuring his thumb.

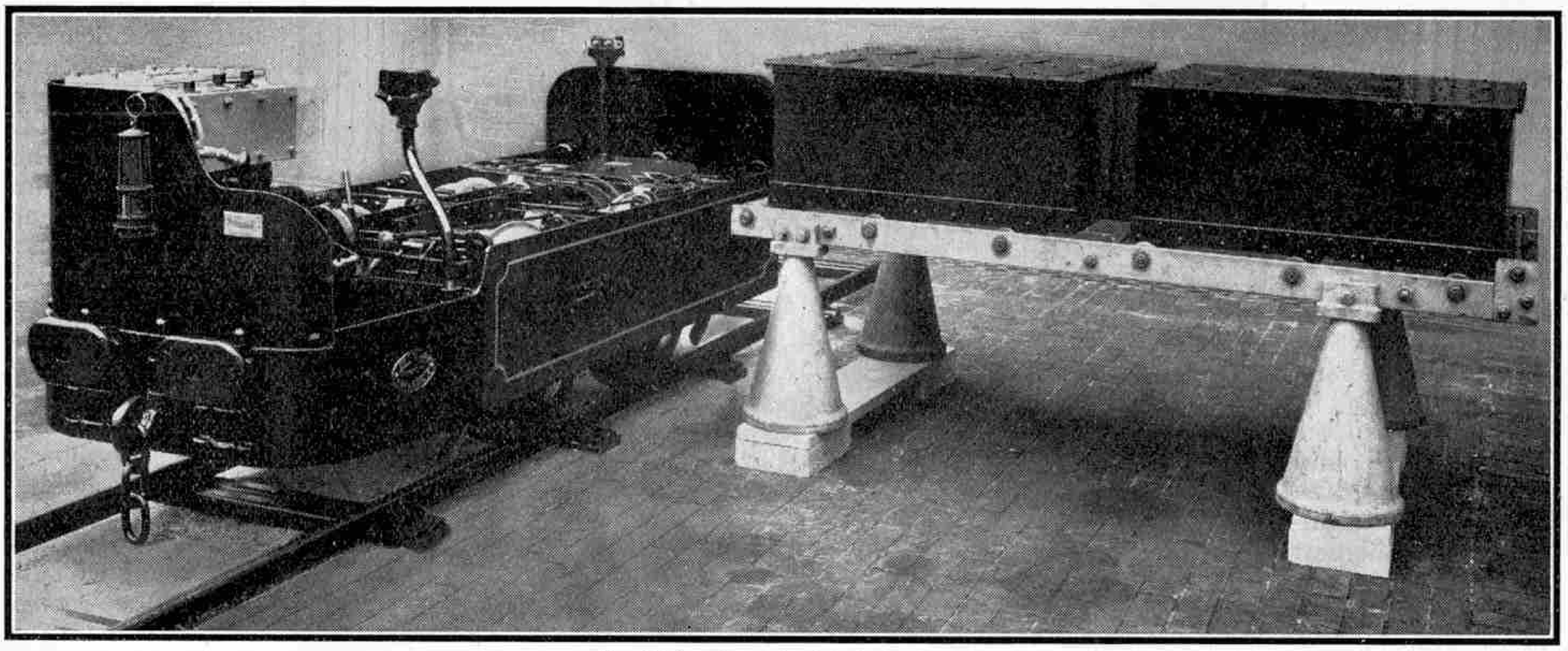
When the carman and vanguard were in the same vicinity about three weeks later, the latter observed a man whom he recognised as the thief, and promptly informed the carman, who had him challenged and taken into custody by a City constable.

There was a sequel in the Manchester City Police Court when the thief, who proved to be an old offender, was sent to gaol for six months.

The carman and vanguard have been awarded gratuities for their vigilance and prompt action, and the former has been compensated for the damage to his teeth.—" *G.W.R. Magazine.*"

Loco that Won £1,000 Prize

An Interesting Electric Loco for Use in Collieries



The Colliery Loco about to be loaded up

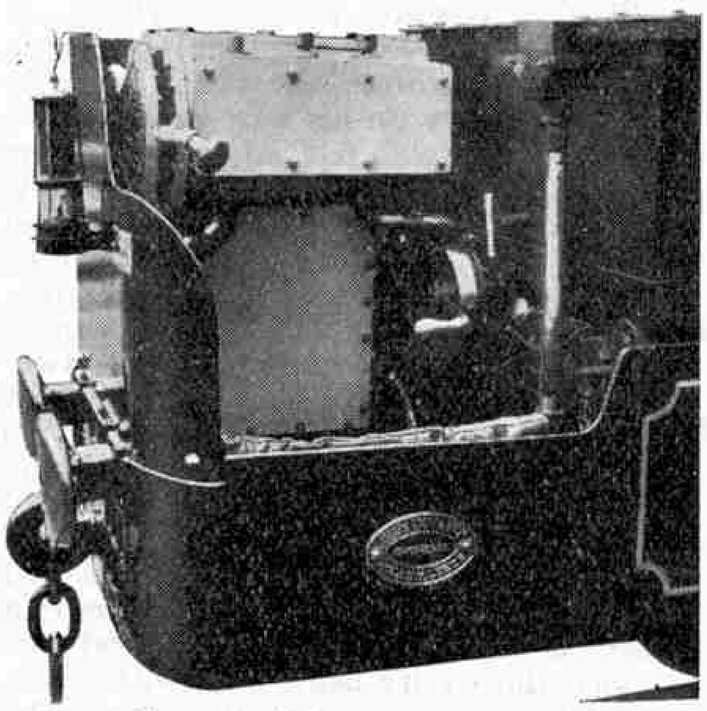
RATHER more than three years ago Mr. Charles Markham of Chesterfield, offered a prize of £1,000 for a colliery loco to be used underground to replace ponies for hauling coal tubs. Ten locos were entered and five were selected for tests that were carried out at the Brodsworth Main Colliery, Doncaster.

This article describes a new colliery locomotive of the type that is rapidly gaining favour for use underground. The use of these small locomotives will eliminate, at any rate to a certain extent, the use of pit ponies. Owing to the unnatural life they necessarily have to lead, these creatures have always been the subject of considerable sympathy from those interested in the well-being of animals.

As a result of those tests the prize was awarded to the "Union" patent electric storage battery loco, designed and constructed by Messrs. Joseph Booth & Bros. Ltd., of Rodley, near Leeds. Since the competition the general design has been somewhat altered and improved.

The loco is of 2 ft. gauge with a wheelbase of 2 ft. 3 in., the wheel diameters being 22½ in. and the road clearance between the wheels above the top of the rails 5⅞ in. The overall length is 10 ft., the width and height each being 3 ft. 6 in. The loco has a starting pull of 2,000 lb. and is capable of hauling five tons on the level at a speed of approximately 6 m.p.h. or twenty tons at 3 m.p.h.

Special attention has been paid to securing the utmost accessibility. The battery cells are mounted in groups in hardwood crates and housed in flame-proof mild steel boxes. These boxes are supported on rollers mounted in the loco frame and locked in position by two pivoted bars, one on each side of the loco and running the full length of the boxes, each being securely clamped by a single-hinged bolt.



The "cab," showing control levers

The cables are taken in and out of the boxes by quick releasing plugs. When the battery becomes discharged all that is necessary is to release the plugs and the one clamping nut, pivot the locking bar over and roll the battery off the machine. A fully charged battery can then be rolled into position, the whole operation occupying less than five minutes. The removal of the battery lays open for inspection the whole of the mechanism.

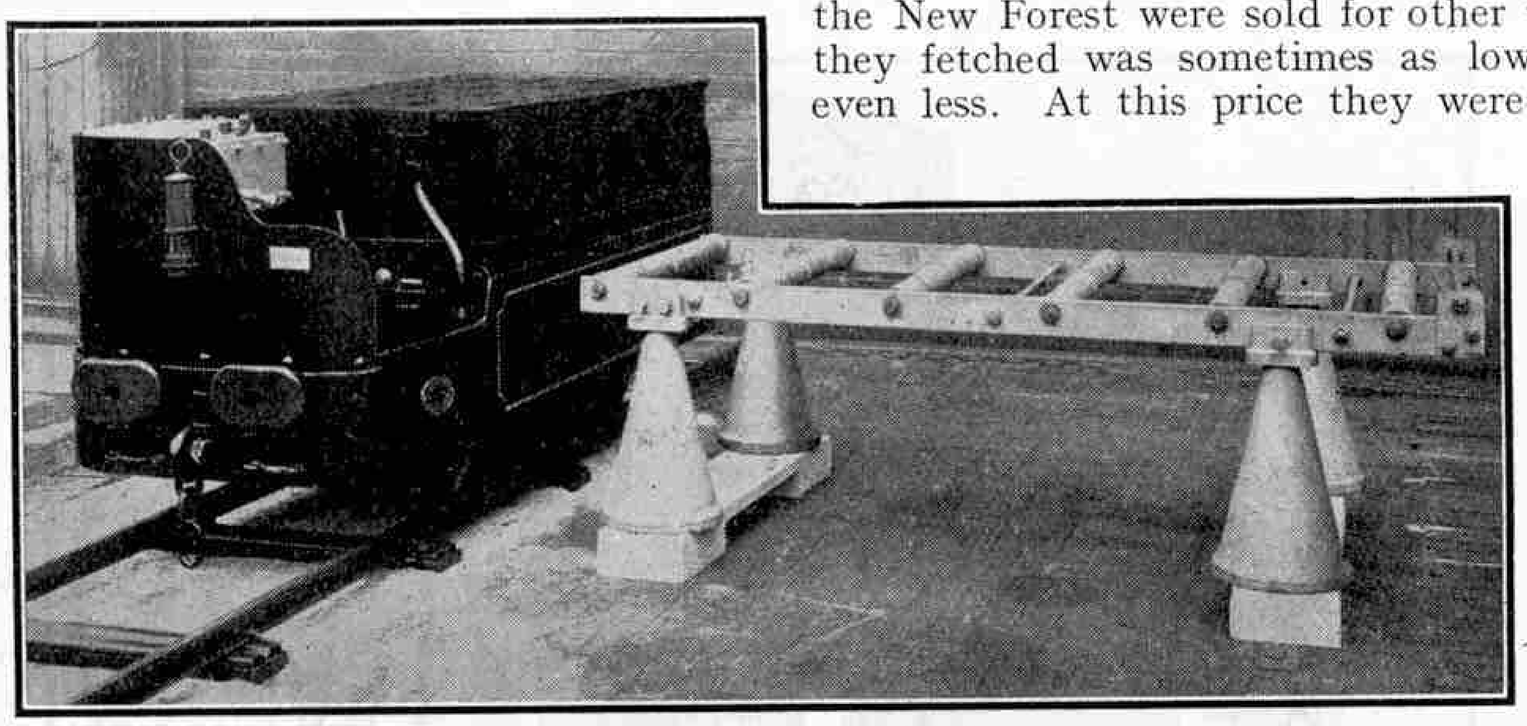
Power is derived from a motor of robust proportions placed at the opposite end of the loco from the driver and is transmitted through two flexible couplings and cardan shaft to a high-efficiency free coasting worm and wheel on the axle nearest to the driver. Powerful brake gear operating on the rims of all four wheels is fitted and sanding equipment is provided for each wheel, the sand being conducted to the rails through rubber pipes that cannot be damaged by derailment or by contact with any projecting object.

The loco is composed of two units, mechanical and electrical respectively. The mechanical unit consists of the two axles and brake gear mounted on an inner frame, and the electrical unit of an outer frame carrying the motor, controller, resistance, circuit braker and all electric cables. When overhaul becomes necessary

the two units can be separated by unskilled labour, no severance of electrical connections being involved.

The spring-mounted draw-hooks and buffers are worthy of special note as they reduce the shock to loco and battery when starting and stopping. Another advantage of the spring draw-hook is that the strain on the links connecting the loaded tubs is greatly reduced.

Great care has been taken to produce a thoroughly flame-proof construction. The electrical units are equipped with flame-proof terminal boxes, fixed insulated studs being provided for carrying the conductors from the terminal boxes into the main housings. This is necessary because of danger of explosion.



The Load in position on the Loco

All material liable to catch fire or to be affected by excessive heat is thoroughly encased and if any part should take fire it would be impossible for the flame to reach the external air.

The introduction of these colliery locomotives should ultimately render unnecessary the use of ponies, now employed in most mines for hauling the coal tubs. Thousands of these pit ponies in this country alone are condemned to live hundreds of feet below the ground and in total darkness. Although it is pleasing to know that they are treated kindly and are housed in clean stables, and well fed, none of these facts can compensate these fine little animals for the loss of their natural surroundings.

Large numbers of these pit ponies are obtained from the New Forest, where they run wild. Every now and then there are organised "round-ups" by the owners of these herds and the high-spirited little creatures captured are sold for work in the mines.

During the strike last year, when the demand for new pit ponies did not exist, the ponies captured in the New Forest were sold for other uses, and the price they fetched was sometimes as low as £3 apiece or even less. At this price they were worth buying for the sake of their hides alone and it is believed that large numbers of these charming little creatures were sold for slaughter for this purpose.

Incidentally it may be remarked that coal strikes have their pleasant side, at any rate as far as pit ponies are concerned. When the pits are closed all the ponies are brought to the surface and they may then be seen grazing in the fields around the pit-heads or gambolling in the summer sunshine, thoroughly enjoying life and quite happy in the fresh air and daylight again.

We all hope that the introduction of the new colliery locomotive into the mines may be speeded up, so that many, if not all, the ponies at present employed may be given their freedom and the trapping of the New Forest ponies for work in the mines may no longer be necessary.

Re-laying Railway Track—

(*Continued from page* 259)

is the packing of the sleepers—that is the completion of ballasting.

By the new method the saving in labour has in actual practice amounted to about 50% as compared with the old method, and there is obviously much less risk of injury to men—a very important item—or of damage to material.

The Track-layer necessitates possession of the road for its most effective operation, but as it operates quite as well by night as by day, being very efficiently illuminated, there must be few places on any railway at which it cannot be used. In any case, where the Track-layer is used, the saving in cost is great enough to justify special arrangements even at the expense of some temporary traffic inconvenience.

The old re-laying methods necessitate restricted speed with consequent traffic delays, for, in some cases, several weeks. The new method does not require more than two or three days' speed restriction, and is generally efficient within retaining walls, tunnels and between platform walls.

It has been proved that the distribution of new materials and the collection of all old materials at a central materials-depôt not only greatly facilitates the carrying out of re-laying programmes, but also ensures a much closer supervision over the selection of those portions of released track that are to be re-used for re-laying on secondary lines and sidings. It is also to be noted that since no materials are at any time lying along the line the store-keeping work is very much simplified. It is, of course, obvious that this machine will as effectively re-lay second-hand track as new track. Such second-hand track may be re-laid on secondary lines or sidings while still in the original, assembled condition, or may be built up from selected second-hand material in the central depôt.

We have to thank Herbert Morris Limited of Loughborough for supplying the illustrations and for supplying the information on which the article is based.

The Story of Coal—(*continued from page* 205)

on being set agoing was christened '*The Wonder.*' About Christmas 1838 the shaft had been carried down to a depth of about 900 ft. at an expenditure of £11,534 9s. 0d., and everybody was on the tip-toe of expectation. The opinion was general that Mr. Whitehouse, the superintendent, had bored through a vein of coal seven feet thick.

"Those who were not fortunate enough to hold shares blamed themselves for their folly; those who held them began to calculate upon the great source of wealth they would one day enjoy."

Some of the people sold their shares for double the price they bought them at.

"One of the largest shareholders made a bet of 100 to 5 that a wagon load of coal, dug out of the company's pit, would be exhibited on the market hill on a certain Monday, and many other bets were laid. A large dinner is stated to have been nearly provided at the 'Peacock;' a carriage and four bands of music ordered; wagons painted blue, and horses proffered to draw the coal into the town.

"But alas! instead of the triumph so confidently anticipated, the brilliant bubble suddenly burst. It was discovered that a cruel hoax had been perpetrated. The workmen, fearing the consequences, betook themselves to flight and on their arrival at Birmingham wrote a letter confessing that, in the absence of Mr. Whitehouse, they had themselves introduced into the boring the coal which had been found!"

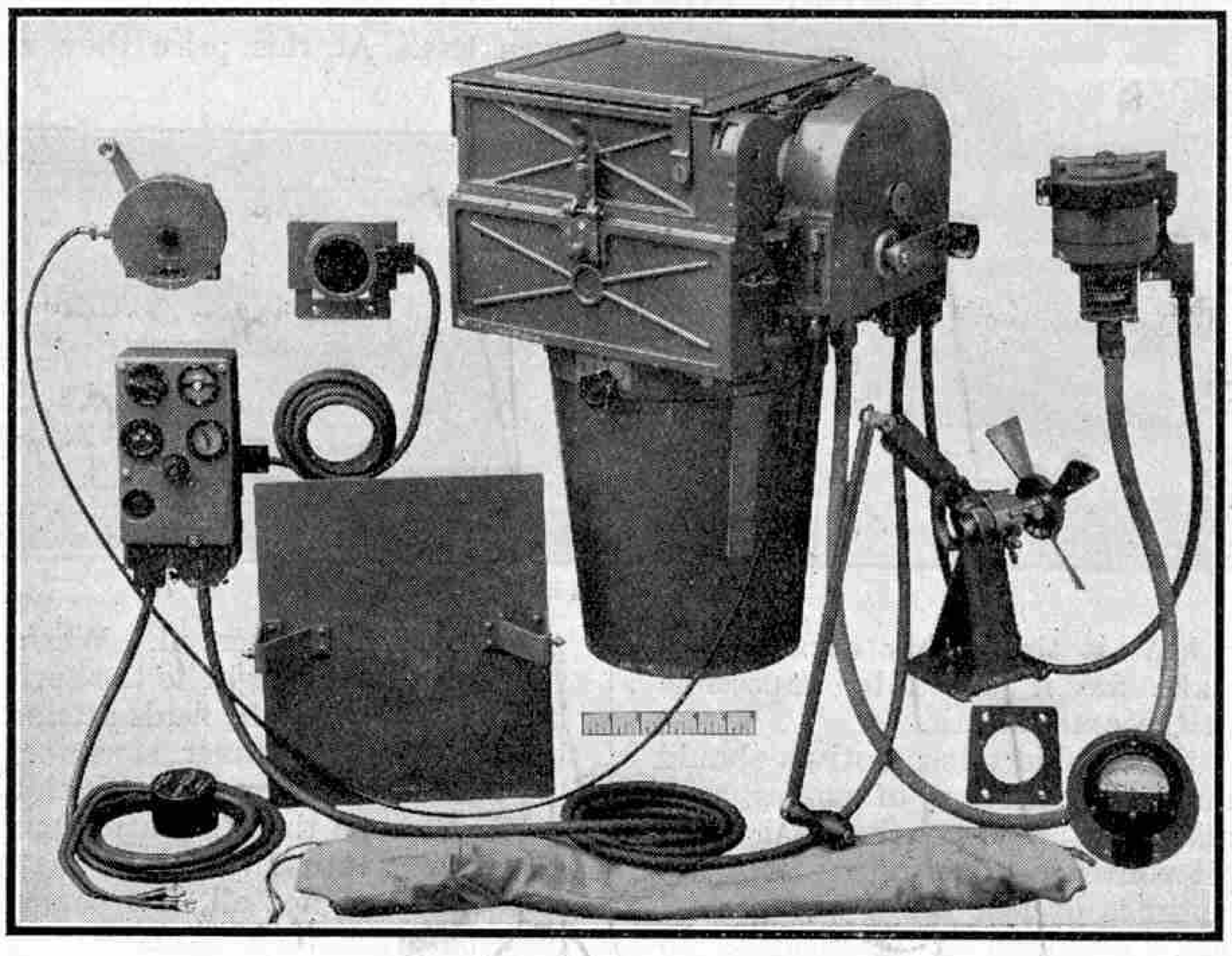
Nowadays, happily, a knowledge of the geological formation of a district largely eliminates the risk of such deception succeeding in its purpose. Boring operations have become more a matter of confirming the existence of coal measures already prophesied by geologists. The accurate geological maps published in this and other countries are valuable aids to prospecting for minerals, and since their inception have been the means of saving much futile boring. Prospectors to-day are able to commence boring operations with a fair certainty of finding what they seek.

MECCANO WRITING PADS are supplied in two sizes, each consisting of 50 printed sheets of tinted paper with cover. Prices—Large, 1/- each, and small, 6d. each (post free), from Meccano Ltd., Binns Road, Liverpool.

Wonderful New Air Camera

Automatically Recording All Details of Photograph

THAT the new science of air photography, born with the war, did not die with the Armistice, is very evident from an inspection of a new air camera to be used for the air survey contract that is about to be carried out in Northern Rhodesia. This interesting piece of apparatus was demonstrated in London by the Aircraft Operating Company, before the Delegates of the Dominion Conference, at the request of Sir Samuel Hoare, the Secretary of State for Air.

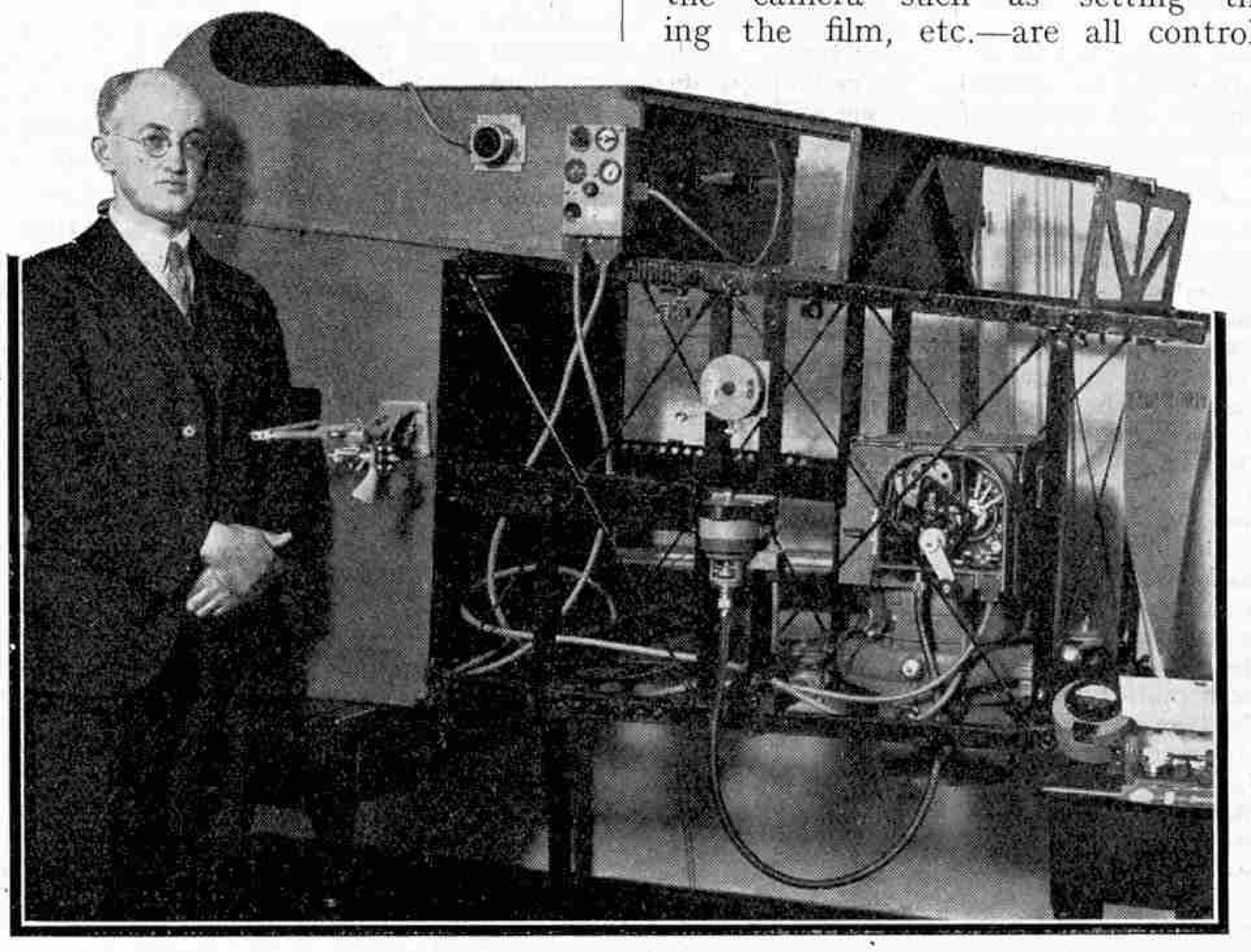


The Eagle Automatic Electric Camera

The Eagle Air Camera, as it is called, will take single views, mosaics, oblique, and stereoscopic views. With a single loading exposures may be made at exactly the correct interval of time. It is thus possible for the consecutive pictures to be made to match correctly and to form a continuous strip map extending over a distance of from 100 to 500 miles. The photographs measure 7 in. by 7 in. The films are panchromatic and each is 9 in. in width and 65 ft. in length, there being thus sufficient film for 100 exposures.

On every negative is recorded not only the date but also the exact hour, minute and second of exposure; the height at which the aeroplane was flying; the angle of inclination to the ground beneath; a serial number; the scale; type of aeroplane used—in fact all the information likely to be of assistance for surveying or map-making. Amid all this data it is strange, however, that no provision is made for indicating the points of the compass. This is not absolutely necessary, perhaps, for in most cases the shadows cast on the ground, taken in conjunction with the time, will afford sufficient indication of the direction of north and south.

Exposure details are recorded automatically when the exposure is made, and the various operations of the camera—such as setting the shutter, winding the film, etc.—are all controlled from a small switchboard.



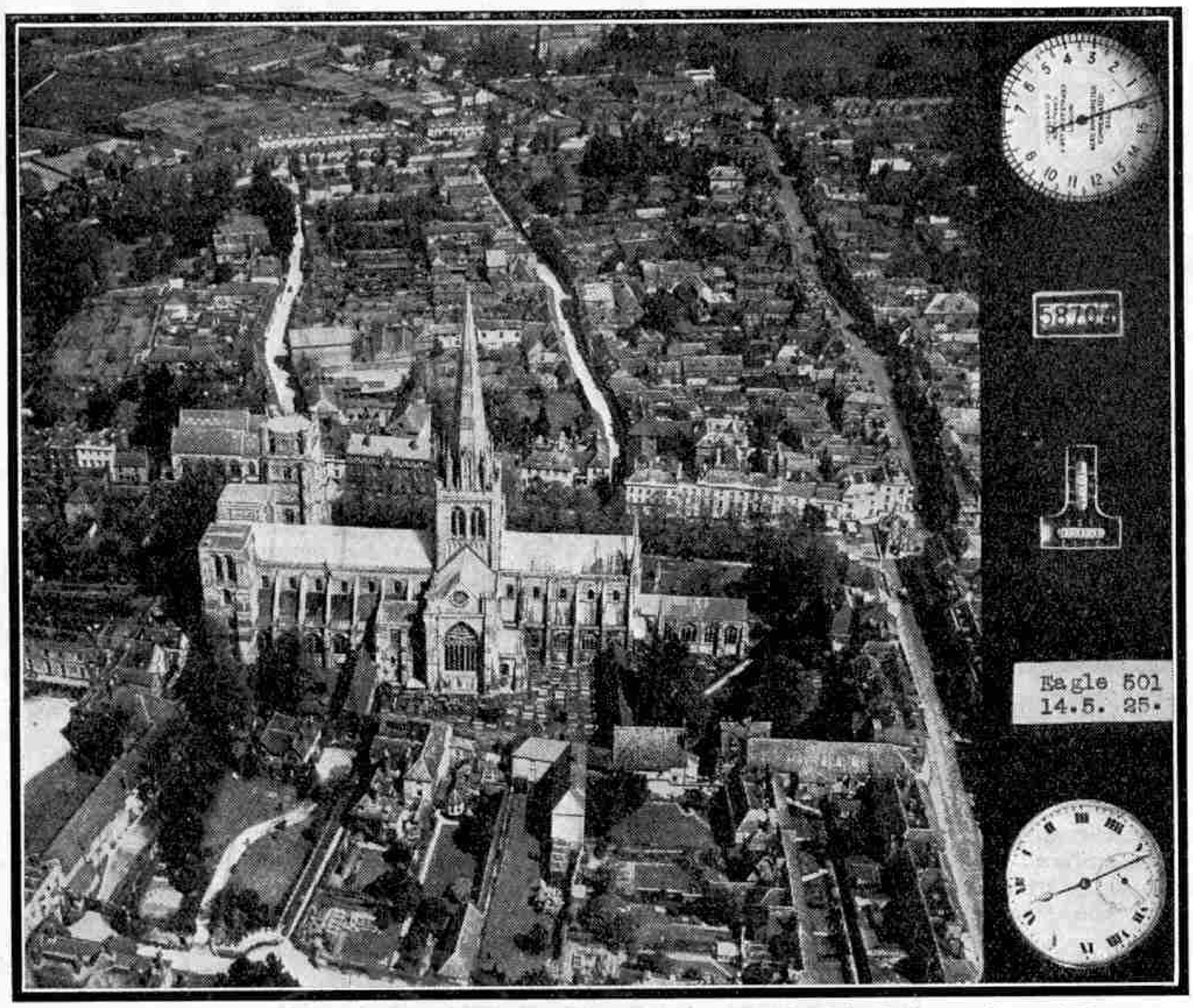
The Camera mounted in a fuselage

This switchboard, usually mounted in the pilot's cockpit, is no larger than a cigar box. It indicates to the pilot that the various movements of the camera are working correctly. It also carries a red lamp, not unlike the tail lamp of a motor car, to warn the pilot that a photograph is about to be taken, so that he may keep the aeroplane as steady as possible during the exposure.

The body of the

camera, which carries the lens cone, gear-box, instrument box, focal plane shutter and magazine, is made entirely of aluminium. A recess is provided in the top of the body to accommodate the film register plate, which is of specially selected glass provided with the necessary collimating points.

The film magazine is also made of aluminium and is attached by spring clips to the camera body. Several spare loaded magazines may be carried in the aeroplane and may be attached whilst in flight. A separate compartment of the magazine contains the gearing, the counter indicating the number of exposures made, and the indicator that shows at a glance when the film magazine is functioning correctly. The frame carrying the film spools is provided with a pressure pad, mechanically operated when the film is stationary, to hold the film flat in the focal plate at the moment of exposure.



Specimen view (Chichester) taken by the new Camera, showing record of details in margin on right

The lens cone is adapted to take any lens from 7 in. to 20 in. focal length. The standard lenses supplied have an aperture of F.4.5. The focal plane shutter is set to give an exposure of 1/90th of a second, variations of exposure being made by means of an iris diaphragm. The actinic value of the exposure at "open" aperture, however, is ample for a good negative on a day of low light value.

As the camera was originally designed for mapping unexplored territory, every precaution has been taken against stoppages. Normally the mechanism is driven by a 12-volt electric motor, but should the current fail, the mechanism can be driven by an air propeller and, failing that, by hand.

The method of supporting the camera in the aeroplane is such that it may be set at any desired angle to correct the changing position of the aeroplane to the horizontal. The camera may also be rotated in its supports to allow for drift due to a side wind.

The weight of the camera varies from 41 lb. to 51 lb. according to the size of lens fitted, while the other components weigh about 40 lb.; spare magazines, with 100 - exposure film, weigh 14 lb. each. The price of this camera is, we understand, £250, and several are already in use by the Royal Air Force, by whom it is known as the "Service Type F/8."

The Eagle Air Camera may be said to mark a distinct advance in air photographic survey, for it will enable large tracts of country to be mapped accurately at a cost comparing most favourably with ground surveys and with an immense saving of time. It is satisfactory to know that, with regard to air photography at least, British firms have established a lead that in all probability will shortly be followed throughout the world.

The Night Mail

It is night and the long platforms are deserted but for a few travellers, who walk about with their collars turned well up. Few porters are to be seen. The glaring lamps illuminate patches of stone, and leave queer, flickering shadows behind columns and corners.

A tiny signal arm, tucked under the glass roof, drops and its red changes to green. Porters appear with baggage, postmen with trucks of mail-bags. The passengers gather up their armfuls of luggage and gaze with expectant eyes at the far end of the station.

From the blackness there an engine appears, gliding swiftly out of the gloom. The two bright buffer-lamps betoken the express. With a vast simmering of steam, and a grind of brake metal, the green giant draws to rest. Her long train of fine solid-looking coaches stands behind her. Windows are steamed over, and give dim glimpses of occupants sleeping and reading. A fascinating suggestion of white cloth, flowers, and glassware comes from the great dining car.

The splendidly massive *Caldicot Castle* stands resting, and gathering strength for the next race through the sleeping countryside. What a figure of romance she is. Bred of long lines of steel greyhounds, she stands, the culmination of locomotive construction. From bogies to powerful funnel, from cylinders to sizzling safety valves, and from huge boiler to cab, she is a thoroughbred.

The driver descends from his cab, a greasy figure with oil-can and waste. While his mighty steed stands, as it were, pawing the ground and anxious to be off again, he clambers under her cross-head guides and motion, giving a drop of oil here, and feeling the heat of something there.

The mails have been loaded, the passengers have entrained, and the doors are slammed. A vast plume of white steam surges into the foggy atmosphere. The steam blast rumbles through the chimney. The station lights gleam wanly on nameplate and splashers. The guard's whistle goes, answered with a shriek by the engine. The fireman starts her going gently, and the driver swings up to the footplate majestically, unhurried, as the great engine throbs from the platform.

Caldicot Castle threshes away into the murky night, pulling so strongly that her red breath pulses and flashes from the fire-door. The great string of human freighted coaches slips by, and is gone.—G. W. G. in the "*G.W.R. Magazine.*"

OBJECTS of the GUILD

To make every boy's life brighter and happier.

To foster clean-mindedness, truthfulness, ambition and initiative in boys.

To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

The Meccano Guild

With the Secretary

Further Exhibition Models

In last month's notes I drew attention to the possibilities of the Silhouettograph and Meccanograph models when used at Exhibitions. I would also suggest that the humorous side of Meccano should not be forgotten on these occasions. Club Leaders and secretaries will no doubt remember the extensive series of models described under the title "Discoveries in Meccanoland" and "Adventures in Meccanoland" in our issues during 1925 and 1926, the last two articles in the series appearing in the February and March magazines of last year.

Those models will, I am sure, amuse visitors very greatly. Older people will be vastly amused at the antics of the disappearing Meccanitian and Major McCahno is certainly worthy of introduction along with the smallest inhabitant of Meccanoland. Younger people also will be eager to attempt to score a penalty goal against the Meccano goal-keeper, and will no doubt be willing to pay a small fee for the privilege.

An Editor in Hospital

No, it is not the Editor of the "*M.M.*" Great sighs of relief! It is Robert G. Middleton, the editor of the Magazine of his Meccano Club, Birmingham, who has written to me from the eye hospital where he is undergoing treatment.

I mention him here as an illustration of a way in which enthusiasm for Meccano can be of value in the somewhat depressing atmosphere of a hospital. This energetic editor keeps the nurses amused with the aid of the jokes in the "*M.M.*" and runs little competitions among the younger patients in his ward for small prizes provided by himself. In addition to this he finds time to make up a few jokes to send along for the "Fireside Fun" pages.

Nurses and patients alike will find themselves a little duller when Robert Middleton leaves. Nevertheless I wish him a speedy recovery and return to his normal activities.

Sir Walter Raleigh and Jackie Coogan together at Exeter! Our photograph shows a group at the Carnival Exhibition recently held by the Exeter M.C.

Club Work in Canada

I have recently heard from the Secretary of the Winnipeg division of the Manitoba Meccano Club, and have found his letter very interesting. It is obviously a very live Club and possesses one feature that appears to me worthy of introduction into many other clubs. This is the formation of an engineering committee. There are four members of this committee, and its purpose is to construct and explain models in the Meccano Standard Mechanisms Manual for the benefit, presumably, of the Club members in general.

Thoroughness is obviously the guiding note of this Club. By the time that the members have worked their way through the Manual they will be well on their way to being fully fledged engineers and I will warn Mr. Hornby that he may expect a flood of Prize-winning models from Winnipeg in the near future.

A New Meccano Guild Map

It will interest Club Secretaries and Leaders to hear that a new Meccano Guild map has been prepared. The first edition of this map was found to be of great value in many ways, especially in the arrangement of inter-club functions, such as football or cricket matches, or joint excursions. On the new map every town or city in which there is a Meccano club is marked with a black circle, and a separate list gives the names of the clubs in those places where there are two or more.

It is hoped also that the map will be of assistance to the "lone" member or to the new Meccano boy who wishes to join a club in his district, and as the address of any club may be obtained from Headquarters the map may be regarded as a complete guide to the Meccano clubs of the British Isles.

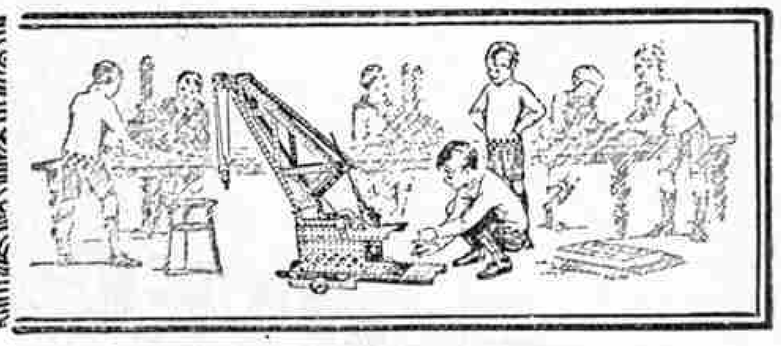
Incidentally, the completion of this map proved to be a greater task than that of the similar one published in the "*M.M.*" in January, 1925, as the number of clubs has increased greatly in the interval. The map will be ready on March 8th, and will be sent to any reader on receipt of an addressed envelope bearing a halfpenny stamp. A free copy will be supplied to every Meccano Club.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given :—

LONDON—ROTHERHITHE : John H. Chandler, 116, Neptune Street, Rotherhithe, S.E.16.
LONDON—BALHAM : G. Masters, 89, Cambray Road, Balham, S.W.11.
LONDON—E.15 : S. Clarke, 73, Gurney Road, London, E.15.
COWDENBEATH—John Paul, Ashburn, Cardenden, Fifeshire.
BARRY—D. B. Lloyd, 12, Clifton Street, Barry, Cardiff.
HOLBEACH—W. Clarke, 6, The Tenters, Holbeach, Lincs.
TREHARRIS—G. P. Edwards, 66, Fell Street, Treharris.
ST. HELENS—T. Ripley, 214, Greenfield Road, St. Helens.
DURHAM—Clifford Turnbull, 10, Whinney Hill, Durham City.

CLUB NOTES



Mutley Grammar School M.C.—Good progress is reported. In alternate weeks members bring models to the club-room, and many good models are exhibited. This club would like to open up correspondence with any other club with the object of stimulating mutual interest. *Secretary*: Kenneth Wills, 8, Beechwood Avenue, Mutley, Plymouth.

St. Albans M.C.—Having obtained a better club-room, meetings are now well attended and the membership shows a steady increase. One of the rules is that if any member fails to attend for three consecutive weeks for any cause other than illness he will be suspended. Model-building is a popular feature and Model-building Evenings have been arranged for the new session. One of the members is making cases to contain a membership card and a subscription card. These are to be sold and the profit placed to club funds. Club roll: 15. *Secretary*: H. M. Upward, 19a, Worley Road, St. Albans, Herts.

South Park M.C.—Several interesting Lantern Lectures have been delivered and greatly enjoyed. "South Africa" was the subject of one lecture and another dealt with "The Isle of Man." A recent Exhibition proved highly successful and Taylor and Kendrick have been specially mentioned for their good work, the former contributing a very efficient Tie-press and the latter a Clock. Club roll: 28. *Secretary*: D. Clayton, 39, Gordon Road, Ilford.

Middlesbrough M.C.—Has been divided into two sections known respectively by the now familiar names, "Nuts" and "Bolts." A. Bradley was elected as Sub-Leader for the "Bolts" and W. H. Appleyard for the "Nuts." The Annual Club Party was attended by 24 members who greatly enjoyed the evening. The club-room was decorated and tea was provided, several ladies very kindly giving their assistance. The President, Mr. W. H. Spiers, gave an interesting talk on "The History of Steam and Pumping Engines." Preparations are on foot for an exhibition, which the Captain of Middlesbrough Football Club, Mr. Wm. Birrell, has promised to open. He will be supported by Mr. G. Camsell, the Middlesbrough centre forward. A "Lecture Night" is to be held every month in future. Club roll: 44. *Secretary*: A. Bradley, 23, Laurel Street, Middlesbrough.

St. Saviours (Tonbridge) M.C.—The popular Leader, Captain Perrott, unfortunately has been obliged to resign, and he will be succeeded by Mr. W. S. Smith. Meetings are well attended and a recent Lecture on "A Man and his Car" was appreciated. The club have adopted Henry Ford's motto: "Everything can be done better than it is being done." Club roll: 15. *Secretary*: C. F. Copper, 91, Shipbourne Road, Tonbridge.

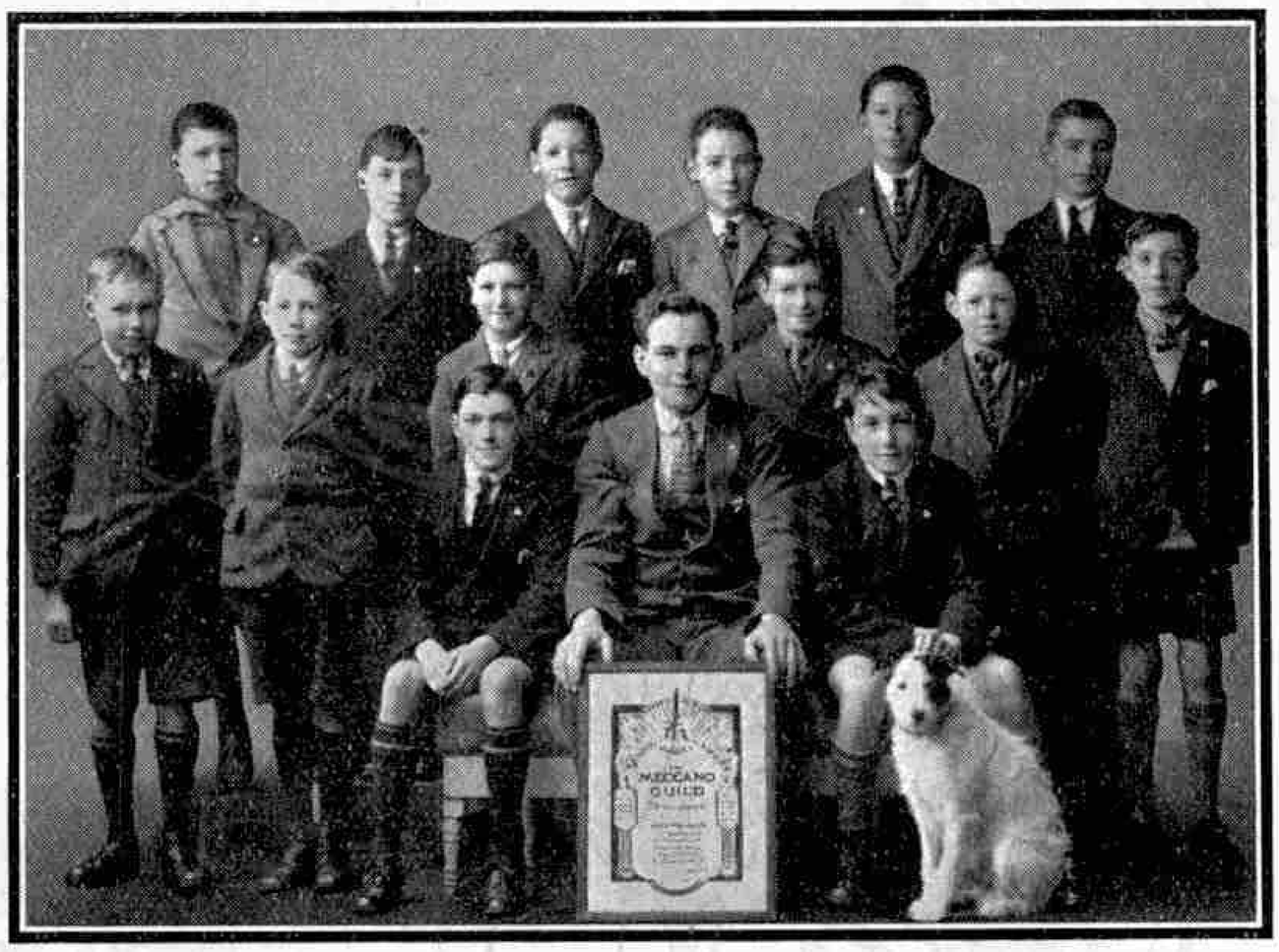
Beccles Excelsior M.C.—Good progress is reported. The Rev. H. Hardy Holder has been appointed President and with his help it is hoped to start a club Magazine. An Exhibition incorporated in the Congregational Sunday School Flower Show was to be held during last month, and a prize awarded for the best model exhibited. A Social is being organised and each member will be asked to bring a friend who possesses a Meccano outfit. It is hoped in this way to recruit more members to the club. Future activities include Games Evenings, Painting and Meccano Model-building. Club roll: 24. *Secretary*: B. J. Andrews, 30, Station Road, Beccles, Suffolk.

Tenterden M.C.—Several interesting Lectures have been delivered and are greatly enjoyed. Model-building is popular and several Games Evenings have been held. An Exhibition has been arranged. Club roll: 29. Leader: Mr. H. Clare, Tenterden.

Derby M.C.—The membership is rapidly increasing and meetings are well attended. A very interesting Lecture was delivered by the secretary on "Pyrotechnics," and this was very much enjoyed. Other lectures have been given by various gentlemen interested in the club. Organised Walks are proving very popular among the members, who attend regularly. Club roll: 41. *Secretary*: P. H. Speed, 5, Findern Street, Derby.

St. Annes (Bristol) M.C.—Owing to the Vicar being obliged to leave the parish this club is without a club-room, but it is hoped to secure a suitable room very soon. Fretwork is becoming a popular feature of the syllabus and Fretwork Evenings have been arranged for future meetings. Club roll: 23. *Secretary*: J. Davis, 45, Arlington Road, St. Annes Park, Bristol.

Annan Meccano Club



Annan Meccano Club was affiliated with the Guild in May 1926. Mr. J. Gibbons undertook the Leadership at the outset, and he has succeeded in fully maintaining the enthusiasm of the members and in carrying through an excellent and varied syllabus. Lectures by members form a very popular feature and a recently organised stamp section is progressing satisfactorily.

Southport M.C.—A Parents' Night and Exhibition proved very successful, demonstrations being given of Hornby Trains, Printing, Stamps and Fretwork. There was also a large collection of models. Games Evenings are popular, and tugs-of-war were held between the different sections. An interesting Lantern Lecture loaned by the L.M.S. Rly. Co., entitled "A Day in London," was delivered by the secretary, and a number of parents and friends attended. Two other lantern lectures entitled "The Story of London's Underground" and "The Story of London's Omnibus," kindly loaned by the London Underground Railway Company, have been secured for future meetings. Club roll: 18. *Secretary*: W. E. Williamson, 10, Delamere Road, Ainsdale.

Rhos-on-Sea M.C.—A patron of the club gave an interesting talk to the members on his experiences in the Navy, and caused much amusement by his description of "Crossing the Line" on a voyage to Hong Kong. A good paper was read to the club by R. Boase on "A Cup Final." The club Magazine is now to be issued fortnightly. A very thrilling serial story is being published in this journal and is entitled "The Eagle's Claw." Club roll: 26. *Secretary*: G. E. Mellor, "Bradda," Allanson Road, Rhos-on-Sea.

West Bridgford M.C.—The club roll is rapidly increasing and it has been decided to discontinue recruiting for a time. A large Exhibition has been held, at which about 150 boys and 250 adults attended. Club roll: 40. Leader: Mr. N. C. Whitehead, Y.M.C.A., London Road, Nottingham.

Cranham M.C.—Games Evenings are popular and Raffia work is found interesting, some excellent Serviette Rings having been made. New members will be made very welcome. Club roll: 7. *Secretary*: J. C. Cheshire, Post Office, Cranham, Essex.

Exeter M.C.—The most notable event is the starting of a Magazine entitled "The White Triangle." A copy of the first issue has been received at Headquarters and is an excellent number. Several of the members contributed items and the printing was done by H. V. Brading. A big model of a Motor Train has been built. The chassis was constructed in the new coloured Meccano by the "Meccano Section." It was then handed to the "Fretwork Section" who constructed the body work, and finally passed to the "Electrical Section" who fitted the electric lights. A recent lecture by R. Youldon, a member of the Electrical Section, on "Magnets," proved very interesting. Club roll: 255. Sub. Leader and *Secretary*: Mr. L. G. Lendon, "Homeside," 72, Old Tiverton Road, Exeter.

Haslingden Secondary School M.C.—Lectures are now very popular. Dr. G. H. Tupling gave a lecture on "The History of the Cotton Trade," which was greatly enjoyed, and an address on "The Manufacture of Yarn," by Mr. W. Tattersall, aroused great interest. The lecturer showed many samples of yarn in the various stages of manufacture. An Exhibition in the club-room proved very successful. A large Hornby layout was a great attraction, and a Windmill in coloured parts and a Motor Chassis were loaned from Headquarters. Club roll: 36. *Secretary*: Kenneth G. Tupling, 16, Alexandra Terrace, Haslingden, Rossendale Lancs.

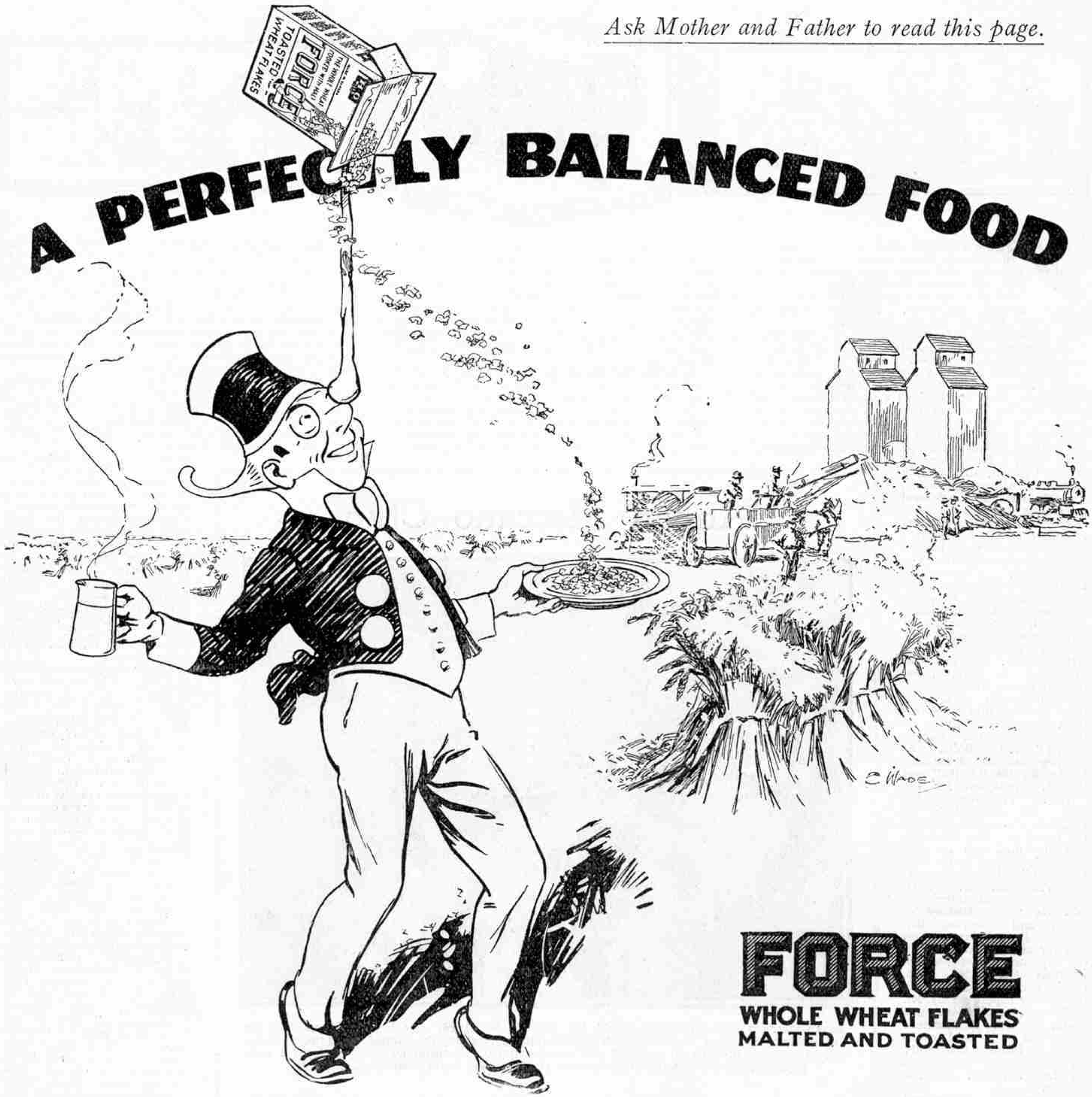
Withington (Manchester) M.C.—A Contractors' Night proved a great success. Two boys, K. Cradduck and E. Saunsbury, were elected "Contractors," each at the head of a gang of "workmen." Rival plans were drawn up for a bridge to be constructed between two tables. These plans were submitted to the Leader, who selected Cradduck's plan as being the more suitable. The Annual Club Party held at the home of the Leader proved very successful. A Stamp Evening has been arranged and Model-building takes a prominent position in the syllabus. Club roll: 11. *Secretary*: Kenneth Cradduck, 36, Mauldeth Road West, Withington, Manchester.

Edgeley (Stockport) M.C.—The fifth anniversary of the club was celebrated recently and enjoyed by all. An interesting Competition has been organised for Indoor Games and is proving very popular. The new session, it is hoped, will be a record one. Club roll: 9. *Secretary*: L. Broadhurst, 29, Glanvor Road, Stockport.

Ashburton School M.C.—Membership is open to boys other than members of Ashburton School, and applicants should write to the Leader. At a recent meeting four tables were set as Aerodromes. One of the older members was appointed "Foreman" of each "Aerodrome," with four younger boys as Engineers. They carried out orders well, and Aeroplanes, Zeppelins, and Searchlights were built. It is proposed to hold a similar evening shortly substituting "Railway Stations" for "Aerodromes," and using Hornby Trains. Club roll: 20. Leader and *Secretary*: Miss C. R. Bolt, 131, Anerley Road, London, S.E.20.

Ask Mother and Father to read this page.

A PERFECTLY BALANCED FOOD



FORCE
WHOLE WHEAT FLAKES
MALTED AND TOASTED

Here's "Sunny Jim," showing us in his own inimitable way, that "Force," the perfectly balanced food, is quick to serve as well. Shake the flakes from packet to plates, add hot milk. Hey Presto! breakfast is served. And a real man's breakfast it is. Strengthening and sustaining, *satisfying*. "Force" stands foremost among fine foods. It's the world's best wheat—*whole Canadian Wheat*—made so you'll *like* it. It's cooked, it's malted, it's toasted. The whole wheat flakes provide a reserve of energy instantly available. That's the advantage of a perfectly balanced food! There's no waste. All you buy you use. Buy a packet to-day.

9½d.

FREE SAMPLE OF "HOLFORCE"

If you have not already tried Holforce Squares of Nourishment made from Force, fill in your name and address and post to Sunny Jim, 197, Gt. Portland Street, London, W.1

Name .....

Address .....

.....

PLEASE USE BLOCK LETTERS

FREE SAMPLE OF "FORCE"

If you have yet to taste "Force," fill in your name and address and forward to Sunny Jim, 197, Gt. Portland Street, London, W.1

Name .....

Address .....

.....

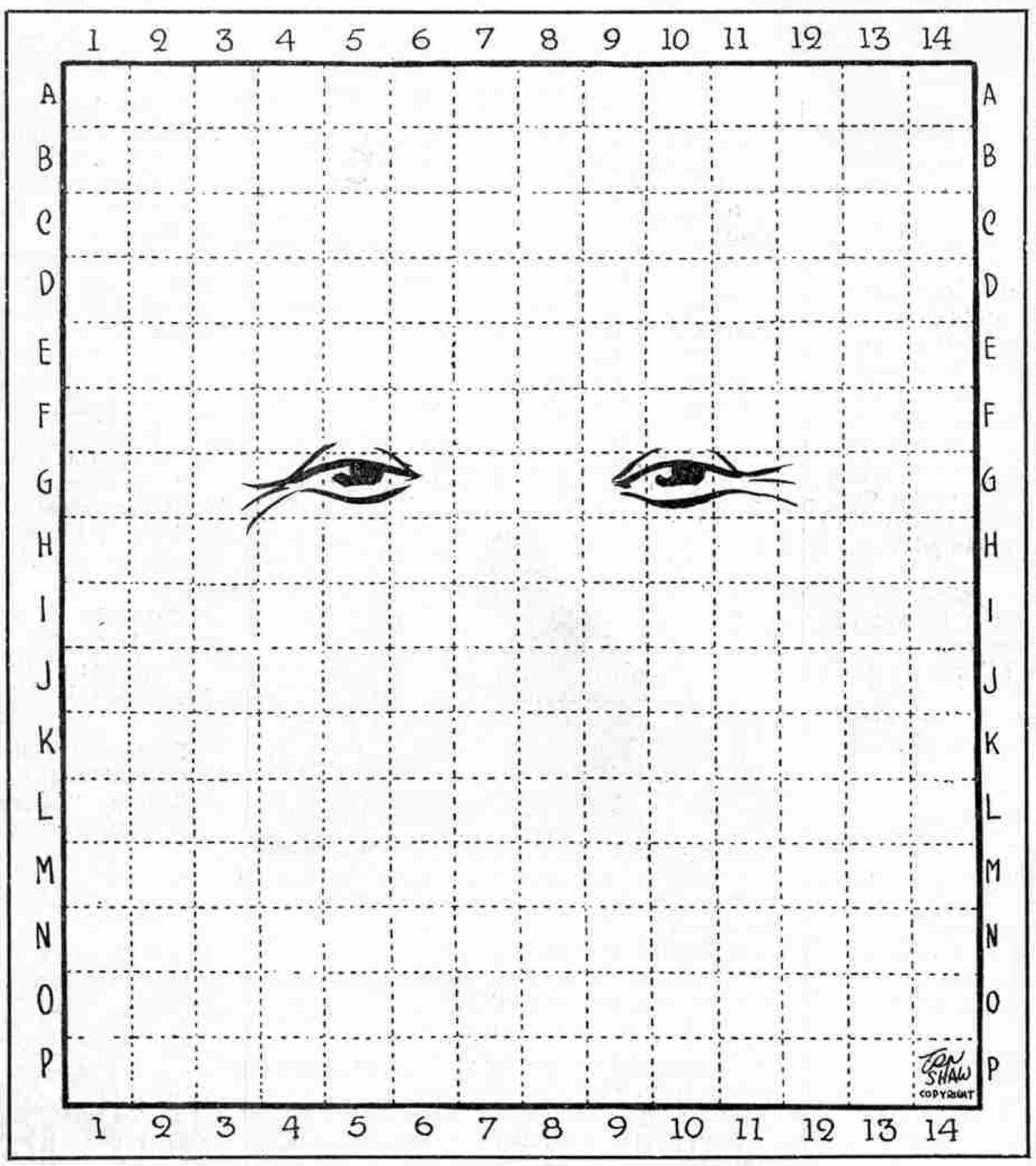
PLEASE USE BLOCK LETTERS

Competition Page

DRAWLINES

The wonderful popularity that attended the "Meccano Boy" cartoon building contest, organised in our December number by "Uncle Ern," the popular wireless cartoonist of 6 K.H., the Hull station of the B.B.C., has led us to decide to organise a similar contest ourselves, "Uncle Ern" providing the cartoon. The selection of a suitable subject was easy! The Meccano Boy's father! After all, the "dear old dad" is just as keen on Meccano as the youngest of our readers.

"Uncle Ern" has made a very careful study of the fathers of several Meccano boys who are known to him and by analysing their faces he has drawn up what he believes to be a face truly representative of those jolly fathers of happy Meccano Boys.



THE MECCANO BOY'S "DAD"

Readers will find it advisable to draw the pencil outline in very lightly first; then it may be gone over carefully in ink, and any mistakes corrected. Any number of entries may be submitted, and a piece of paper, 7"×8", ruled into half-inch squares will be found just as easy to work from as the original blank, and will not entail cutting up the "*M.M.*"

Place your pencil in the centre of G3 and draw continuous straight lines through the following squares. Remember the word "FROM" means begin a FRESH LINE.

FROM
G3 to D2
D2 to C2
C2 to A5
A5 to A10
A10 to B12
B12 to D13
D13 to G12
G12 to J12
J12 to M11
M11 to O9
O9 to O6
O6 to M4
M4 to J3
J3 to G3
G3 to D4
D4 to C5
C5 to C8
C8 to B11
B11 to G12

FROM
L5 to J4
J4 to top right corner of I.6 to centre of I.6
I.6 to J7
J7 to J8
J8 to I.9
I.9 to top left corner of I.9 to centre of J11
J11 to L10

FROM
I.6 to J5
J5 to K5

FROM
I.9 to J10
J10 to K10

FROM
J5 to K7
K7 to K8
K8 to J10
J10 to L8
L8 to L7
L7 to J5

FROM
G3 to top left corner of G3 to centre of G2
G2 to bottom right corner of J2 to centre of J3

FROM
G12 to top right corner of G12 to centre of G13
G13 to bottom left corner of J13 to centre of J12

FROM
G2 to H3

FROM
G13 to H12

FROM
M5 to N6
N6 to N9
N9 to M10

FROM
Bottom left corner of M1 to top right corner of L3

FROM
M4 to bottom right corner of P5

FROM
O7 to bottom left corner of P7

FROM
O8 to bottom right corner of P8

FROM
M11 to bottom left corner of P10

FROM
Top left corner of L12 to bottom right corner of M14

What You Have To Do

You can build up this clever picture simply by following very carefully the instructions given below and on the right hand side of the picture. The blank picture, you will note, consists of a number of squares lettered A to P from the top to the bottom of the picture, and numbered 1 to 14 across. Each square is known by a letter and a number: thus, B5 means the fifth square along in row B.

Unless the instructions state otherwise each line is drawn straight from the centre of the square mentioned to the centre of the square next mentioned. Each line is continuous, straight from point to point until the word "*from*" is reached. That indicates that an entirely new line is to be started from the square that is next mentioned. When the picture is completed, the hair must be shaded in carefully and that portion of the mouth in squares L7 and L8 must also be shaded. Remember to check your drawing over before inking in.

THICKER LINES

FROM
Bottom left corner of E4 to centre of E4
E4 to E6
E6 to F7

FROM
F8 to E9
E9 to E11
E11 to bottom right corner of E11

Every reader young and old is eligible to compete in this novel competition and there is no entrance fee. Prizes of Meccano goods to the value of £2/2, £1/1, 12/6 and 5/– will be awarded respectively to the four most successful solutions and in addition there will be a number of consolation prizes.

Entries will be judged by the Editor in consultation with "Uncle Ern." Their decision is final and no correspondence can be entered into regarding the competition.

Solutions must be addressed to "Drawlines, Meccano Magazine, Binns Road, Liverpool" and sent to reach this office not later than 31st March. Overseas closing date, 30th June.

Fireside Fun

A MATTER OF TIME

Two recruits stationed at a fort overlooking the sea were examining one of the fort guns. One suggested that they should let it off, adding that nobody would be any the wiser. They loaded the gun, one of them holding a bucket over the muzzle to drown the sound. The gun was fired and the shell and the bucket, with the soldier in tow went flying gaily out to sea. An officer immediately rushed up to the remaining soldier to inquire the cause of the commotion.

"Where's Murphy?" he yelled.

"Sure, sorr, he's gone for a bucket of water!" coolly remarked the recruit.

"How long will he be?" roared the officer.

"Well," came the answer, "if he comes back as quick as he went, he's due any minute!"

* * * *

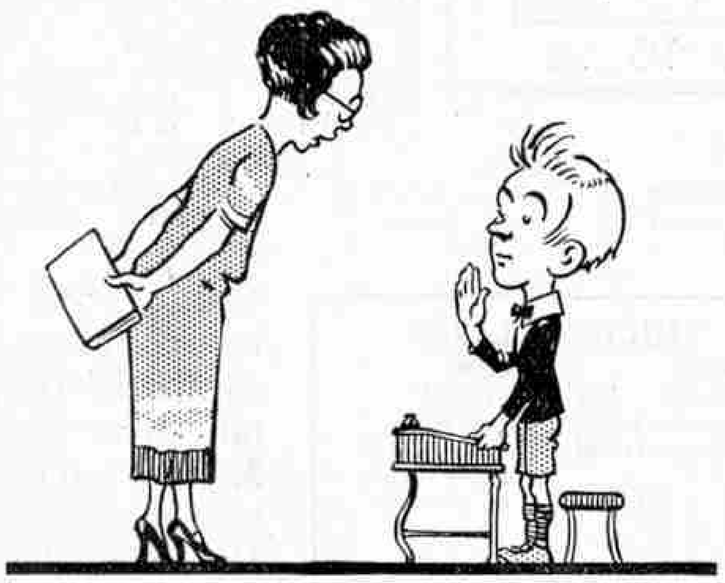
A Yankee was talking to a London boatman in a London fog.

Yankee: "Say! Call this a fog? Why, in New York when there is a fog you cannot see your hand before you!"

Londoner: "What of it? I once sat in a boat on the fog, when suddenly it lifted and dropped me in the river!"

* * * *

MISUNDERSTOOD



Teacher: "Johnny, how many collars do you wear a week?"

"Please, miss, don't you mean how many weeks do I wear a collar."

* * * *

In introducing a noted missionary to his congregation, a coloured preacher in one of the Southern States said: "Dis noted preacher, brethren, is one of the greatest men ob de age. He knows de unknowable, can do the undoable, and can unscrew de unscrutable."

FROM THE LIMERICKS COMPETITION

There was a young lady of Harwich,
Who once wrote an essay on marwich,
She said "All you do
Is to swear to be true,
And then you drive home in a carwich."

* * * *

Officer: "Don't you know you're not supposed to talk while at attention."

Cadet: "No"

Officer: "No, what?"

Cadet: "No talking."

* * * *

ADDING INSULT TO INJURY

Policeman (to motorist whom he has pulled up for speeding): "Wot's yer number?"

Motorist: "A.D. 11."

Policeman: "I want yer number, and not the year she was built."

* * * *

Commercial Traveller: "I got two orders from that firm to-day."

Boss: "Good. What were they?"

Commercial Traveller: "Get out and stay out!"

* * * *

HONESTY!

Two friends were having a mild argument as to whether honesty was or was not the best policy.

"Can you give me a concrete instance," said Smith, "where you have reaped any benefit from being honest?"

"Yes!" replied Brown, "I can. When leaving the tram recently I tendered the conductor a coin, saying, 'You have omitted to collect my penny fare,' when I could easily have left the car without paying."

"Surely you are not going to tell me he rewarded you with a shilling!" said Smith sarcastically.

"Well, not exactly," replied his friend, "but he gave me 5d. change for a threepenny bit!"

* * * *

Q. Who was the father of the Black Prince?

A. Old King Cole.

A GOOD BARGAIN

"Can you read that bottom line?" inquired the optician.

"No, suh," said the negro customer.

"These glasses will fix you so that you can read it." The negro brightened up at this.

"Dat's more'n I expected, boss," he said. "An eddication and a pair ob glasses all for five shillin'. I nebber learned to read!"

* * * *

"Hallo, old man, never saw you walking so fast before. Where are you going?"

"A fellow just stole my bike, and went off down this road."

"But surely you don't expect to overtake him afoot?"

"Don't I? Why, he forgot to take the repair kit with him!"

* * * *

Customer: "Hi! You're giving me too much bone with that beef."

Butcher: "I'm not giving it. You're paying for it!"

* * * *

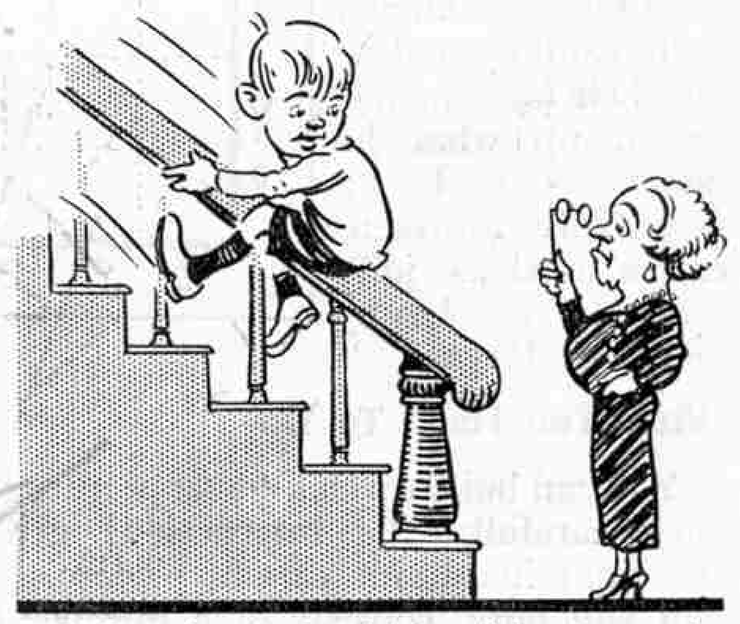
Sentry: "Halt! Who goes there?"

Colonel (angrily): "Blockhead! Fool!"

Sentry: "Advance blockhead and fool, and give the countersign!"

* * * *

SLIDES A. & M.



"Georgie, I shouldn't slide down the bannisters like that."

"Wouldn't you, grandma? Show me how you'd do it."

* * * *

A Scotsman, noticing a bald-headed chemist, inquired if he had any hair restorer. "Why, yes, here's an article that makes hair grow in 24 hours."

"Aweel," said the Scot, "ye can gie the top o' your head a rub wi' it, and I'll look back in the morn and see if you're telling the truth."

* * * *

Q. What stands all day on one leg with its heart on its head?

A. A cabbage.

OUTCLASSED

A Yorkshireman had never been to the races, so he thought he would have a trip to York. Just before the first race, being next to the rails and getting crushed, he climbed over on to the course to get a better view.

The race starting, he made tracks along the course, the horses following hot after him. A policeman, seeing his plight, dragged him out of danger.

"Why didn't you jump the rails, when you saw the horses gaining on you?" asked the policeman.

"Jump the rails?" cried the man. "Why, Ah couldn't beat 'em on't flat, never mind ower t' hurdles!"

* * *

During a dense fog the steamboat slackened speed. A traveller, anxious to get ahead, spoke to the helmsman, asking why they were going so slowly.

"Too much fog. Can't see the river!" came the laconic reply.

"But you can see the stars overhead!"

"Yes!" replied the helmsman, "but we ain't going that way until the boiler bursts!"

* * *

Blobbs: "There goes old Slapdash the artist, I think his work is trash."

Blaggs: "He came round to my place with one of his landscapes, and asked me for a title. I said 'HOME.'"

"Home! why home?"

"Oh! because there's no place like it!"

* * *

Two Irishmen who were old friends met in the street one day.

"Sure, I met a man last week, and bedad I'd have sworn it was yourself," said one.

"And wasn't it?" asked the other.

"Divil a bit!" replied the first. "But he was your very image barrin' he was a trifle grey. I suppose you haven't a twin brother a few years older than yourself?"

* * *

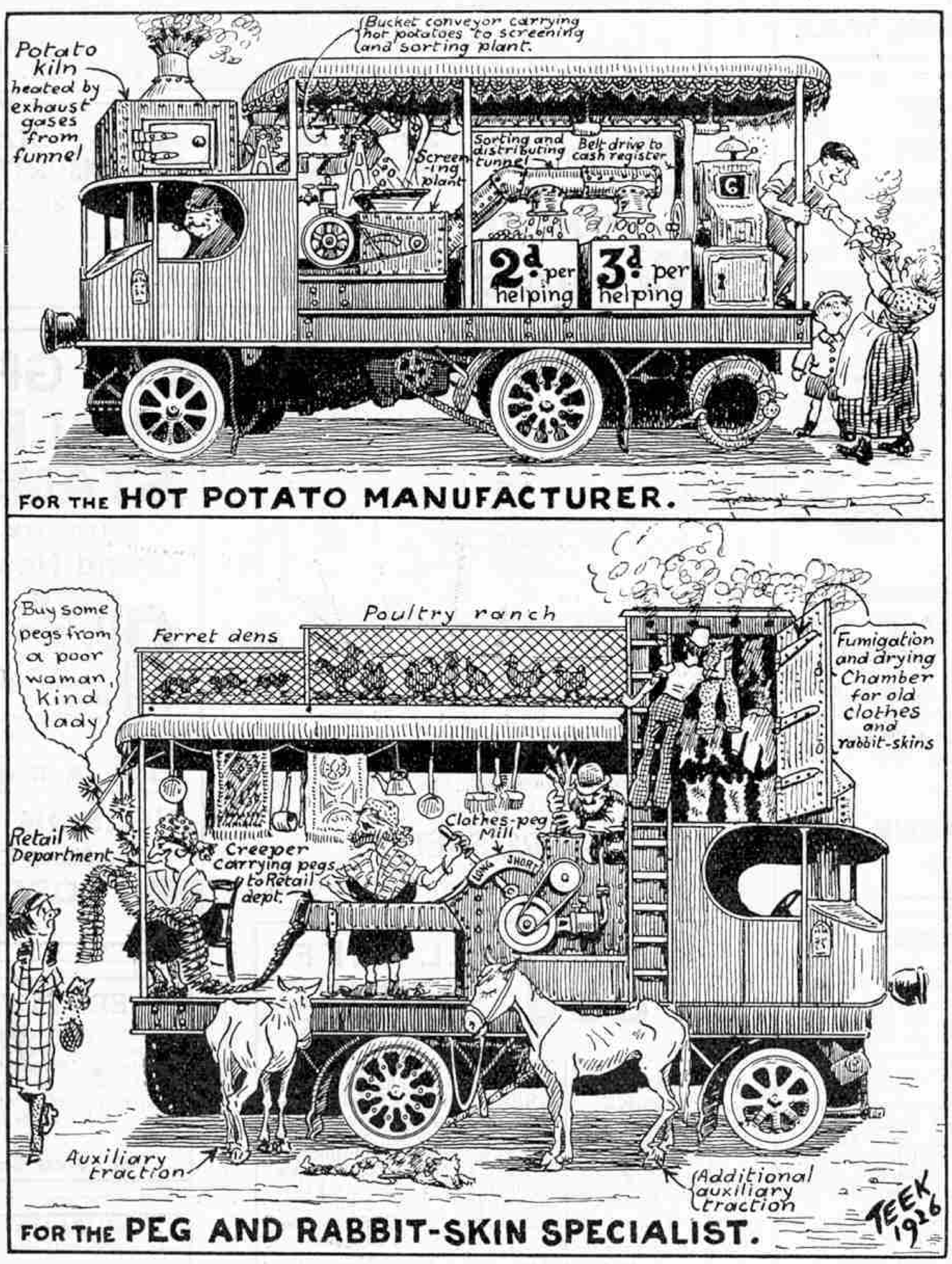
A GOOD SHOT!

A young man was showing a sweet girl his fine collection of East African trophies. Among them was a fine buffalo head which the girl particularly admired.

"What a wonderful head!" said the girl. "How did you get that? Was he very savage?"

"Oh, yes!" replied the young man. "I had the dickens of a time with that buffalo! Never had such a morning in my life! I shot it in my pyjamas."

"Good heavens!" murmured the young thing. "How did it get into them?"



FOR THE **HOT POTATO MANUFACTURER.**

FOR THE **PEG AND RABBIT-SKIN SPECIALIST.**

Courtesy] [*Sentinel Wagon Co. Ltd.*

An Oxford Street flower seller has been seen trading from a saloon car—*Vide* ***"The Motor"***

ALMOST PURE WATER

"How much cider did you make this year?" asked one farmer of another, who had offered him a sample for trial.

"Fifteen barrels," was the answer.

The other took another sip and said: "Well, I reckon if you had another apple you could have made sixteen!"

* * * *

A lady stood on the pier and began chatting with the aged man with a mop. "What are all those ships just going out?" she asked.

"Trawlers, miss."

"And just look at the way those birds are following them."

"They're gulls, waiting to pick up the waste food thrown overboard."

"But there are no seagulls flying after that funny-looking boat!"

"'Tain't no use, miss, replied the aged man, "that's a Scotch boat!"

* * *

Diner: "Waiter, there's a button in this soup."

Waiter (formerly a compositor): "Very sorry, sir. Printer's error—should be mutton!"

* * *

They were experts, but chiefly in the art of bragging. At that particular moment they were discussing their own wonderful feats as vocalists. "Why," said the American, "the first time I sang in public I was simply showered with flowers. Enough in fact, to start a florist's."

"That's nothing," said Pat. "The first toime that I sang was at an open-air concert, and the audience was so delighted they presented me with a house."

"A house," scoffed the American. 'You must be off your head!"

"Faith, and it's true!" said Pat. "They presented me with a house, but begorra, it was a brick at a toime!"

* * *

Visitor: "Who is the responsible man in this firm?"

Office Boy: "I don't know who the responsible party is, but I get all the blame."

* * * *

"I say, you see that murky-looking fellow on the other side of the road?"

"Yes. What about him?"

"Well, he goes about advising people to sleep with their windows wide open."

"Quack doctor, I suppose?"

"Oh, no, he's a burglar!"

In court the lawyer turned to the opposing counsel and said angrily: "You are the biggest idiot I ever saw in my life."

Whereupon the judge gravely remarked: "Silence, sir, please do not forget that I am present."

* * * *

Keeper: "Hi boy! You can't catch fish here without a permit."

Boy: "Oh, shut up! I'm getting on all right with a worm."

"Now," said the teacher at the end of her talk on music, "What is harmonising, Percy?"

"The stuff you put on the top of cakes, miss."

* * * *

Well-meaning old lady: "Thank you so much for your song, my dear. When I shut my eyes and listened to your singing I seemed to hear the dear old gate at home creaking in the wind."

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Send addresses of Stamp Collecting Friends and receive an extra Set Free.

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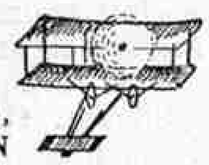

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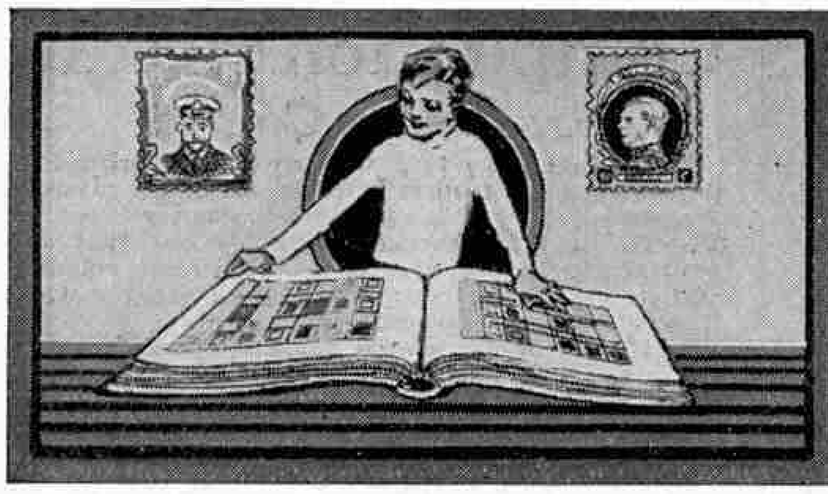


Stamp Collecting

EARLY DAYS FOR THE UNITED STATES

By R. Kay Gresswell

"WE hold . . . that all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty and pursuit of happiness; that to secure these rights governments are instituted among men, deriving their just powers from the consent of the governed; that whenever any form of government becomes destructive of these ends it is the right of the people to alter or abolish it. . ."

These are words taken from the Declaration of Independence that was drawn up by Thomas Jefferson and accepted by the Second Continental Congress on the 4th July 1776, as we related last month. The fine thoughts expressed by these words gave courage to many faltering inhabitants of America who were hesitating whether to remain loyal to England or to join with the rebels and try to win a glorious freedom.

Washington

"We hold that all men are created equal, endowed with unalienable rights; among these are liberty. . ." That was the essence of the whole matter. These men and women objected to being downtrodden by an overbearing, would-be-all-powerful, and unsympathetic government thousands of miles away. That was the spirit of the revolt and can we wonder at their determination to win these rights that meant so much for them?

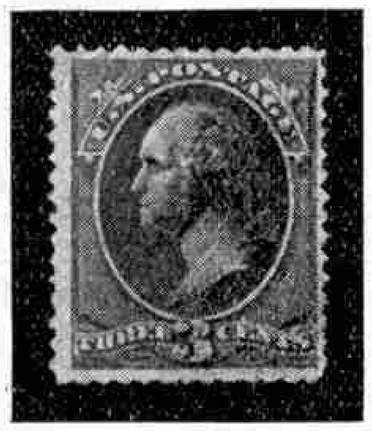
Yet these same people who spoke so freely of every man's "unalienable right" of "liberty" saw no inconsistency in their actions when they whipped their slaves and treated them as animals! But of that we shall say more later when we come to the great anti-slave war that shook the United States to its very foundations.

The War Brought to an end

The American War of Independence lasted until Lord Cornwallis, the officer in charge of the English troops in America, was defeated at Yorktown in 1781. After this there was no more fighting. The English government was forced to submit and negotiations were begun between the two countries as to the terms of peace. Benjamin Franklin and John Adams were two of the American negotiators and very favourable terms were granted to them, with the result that peace was formally ratified on the 3rd September 1783.

Franklin

The United States of America now set about consolidating its position at home, removing the ravages of war and making itself more firmly established on a commercial basis. The country was fortunate in the fact that it had need to import scarcely any goods from other countries, being almost entirely self-supporting in respect of foodstuffs, clothing and other articles of necessity and comfort. This made it possible for it to shut itself out from the world of European politics and to deal only with itself, which made the country much easier to control, as would be expected, but it caused it to acquire a somewhat exaggerated sense of its own importance. Through this the American people obtained an attitude by which they seemed to look down on the Old World as from a pedestal, as much as to say: "We are not one of you. We are different. Your affairs are not our affairs. But we are interested in watching you old folk play at politics and war."



Washington

This attitude lasted for a long time and remnants of it may even be thought by some to remain to-day in America's dealings with Europe. In the 18th and early 19th centuries with their slow locomotion and communication of news, this isolation from the world may have been possible and even advisable, but to-day, when a man in England can telephone to his friends in New York, such isolation is obviously impossible. America is just as much concerned with European affairs as is Europe itself.

The New Constitution

A convention was called in 1787 and it met at Philadelphia with the object of drawing up the Constitution of the new country. Washington was in the chair and the delegates were a very able set of men. There were many discussions and several times there was nearly a deadlock on the question as to whether there should be two houses of government with the states with large populations most powerful or whether there should be instead one house only with each state equally powerful irrespective of its population.

Washington

A compromise was the final solution and it was decided that there should be two houses, in one of which, called the Senate, each state should have equal voting power, and in the other the states with greater population should have greater voting power.

This Constitution was referred to the various states for their approval and it was decided that, if nine of the thirteen states accepted it, it should be considered a settled matter.

Eleven states eventually ratified it, the two rejecting it being North Carolina and Rhode Island. However, a sufficient majority had been obtained and Congress proceeded to fix the dates for the choice of electors and for the choice of president and vice-president. The latter date was the 4th March 1789, and ever since this date has been observed as the one on which presidents have retired from their office.

Franklin

Washington Elected President

On this day George Washington was unanimously elected the first President of the United States of America and John Adams, who became President in 1796, was elected vice-President. There was never any doubt as to who should be the first President and no one thought of voting for any person other than Washington. He was unanimously elected for a second term in 1792 and it was only through his positive refusal to hold the office again in 1796 that he was not elected again in that year.

Franklin

There occurs a number of fine thoughts in Washington's inaugural speech made in New York about six weeks after he had

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Postage 2½d. extra. Abroad 6d. ex.
WATKINS (M. Dept.), GRANVILLE ROAD, BARNET, HERTS.

Competition Results

Lynx Eye Contest

Any secret hope that we may have cherished of confounding our readers with the aid of the mystery fragments used in this competition, was very speedily dispelled and it became quickly evident that our readers generally study the advertisement columns just as closely as those devoted to literary matter. The entries were extremely heavy.

Only five of the puzzle pictures counted in the judging. A fragment of Franber & Co.'s December advertisement was used but the article from which it was taken was not illustrated in the January advertisement so that the picture was disregarded.

The remaining five solutions were as follows :—1, E. J. Riley Ltd.; carpet under billiard table. 2, Force ; Sunny Jim's pigtail. 4, W. E. Appleby & Co. ; portion of lower wing of aeroplane. 5, Lines Bros. Ltd. ; framing of trademark. 6, Worboys and Smart ; portion of side of "Super" model engine.

The prizes were awarded to the following :—1. W. LEITCH (Greenock) ; 2. E. DAY (Shepherds Bush, W.12) ; 3. A. N. READ (Faringdon, Berks.)

Consolation Prizes : T. BOUNDY (Birkenhead) ; S. A. GREGORY (Seven Kings, Essex) ; W. F. HENSON (Derby) ; A. E. JERROMES (Birmingham) ; P. LUCA (Stockport) ; T. PRENTICE (Eastbourne) ; H. R. STORER (Scarborough) ; B. THOMSON (Newport)

January Stamp Contest

In this contest readers were required to design an air post stamp for the use of "Meccanoland" and a considerable amount of designing skill was displayed. The entries were by far the greatest in number that we have ever had submitted to a stamp contest and as was to be expected in such conditions, the competition was very keen.

The winning design is a splendid representation of a biplane flying along a valley bordered by hills. The colouring, crimson on a white ground, is extremely effective. The stamp value, 3d., appears in figures in four corner tablets and in words in the side tablets. The words "Air Post" appear in a tablet across the top of the stamp and the name of the issuing country "Meccanoland" in a similar tablet at the foot of the stamp. The lettering is excellently drawn and the colouring is in conformity with the general scheme.

At a later date we hope to reproduce a number of the best efforts.

The prizes were awarded as follows :—1. W. FOSTER (Widnes) ; 2. R. BATESON (Harrogate) ; 3. C. HOADLEY (Penge, S.E.20). Extra prize : B. HARGREAVES (Southport). Honourable Mention : A. BURNHAM (Shepherds Bush) ; J. CAMBRIDGE (Dover) ; A. P. CORT (Blackburn) ; N. EDGAR (Blaydon-on-Tyne) ; G. F. MATHER (Frodsham) ; A. H. S. MEGAW (Belfast) ; R. W. SANDERS (Cardiff) ; C. J. SNOW (Streatham Hill).

"If I Were Editor" Essay

Some extremely interesting suggestions were offered by entrants to this contest but until a thorough investigation of their possibilities has been made, it is not possible to comment at length. Every point put forward is being carefully examined, but it is, of course, too early to say whether the ideas will be adopted. First Prizes : Section A, G. A. ADAMSON (Caterham) ; Section B, L. DAY (Walsall). Second Prizes : Section A, H. S. FISHER (Stow-on-the-Wold) ; Section B, R. WYETH (Redhill). Consolation Prizes : Section A, G. S. MARSH (Blackpool) ; Section B, J. K. THOMPSON (Dover) ; J. B. SCRONCROFT (Torquay) ; D. MASSEY (Bexhill-on-Sea).

January Puzzles

The solutions to this set of puzzles appeared last month and those competitors who met with difficulty will, by now, have discovered their errors. The prizes are awarded to the following competitors :—1. E. J. DICKIE (Muswell Hill, N.10) ; 2. W. TYE (Ipswich) ; G. D. COXHEAD (Wanstead, E.11). Consolation prizes : C. N. BEATTIE (Lewes) ; A. YOUNG (Dundee).

Overseas Results

"Limericks"

1. J. HARDING (Novia Scotia) ; 2. M. HARRIS (Trinidad) ; 3. J. PAULI (Queensland). Consolation Prizes : M. CONRAD (Brisbane) ; E. HOLDER (Port-of-Spain).

"My Favourite Cover"

First Prizes : Section A, E. HOLDER (Port-of-Spain) ; Section B : J. R. THOMAS (Dunedin) ; Second Prizes : Section A, R. GARCIA (Trinidad) ; Section B, W. LAWS (Hastings, N.Z.)

18th Drawing Contest

First Prizes : Section A, S. GOLDES (Malta) ; Section B, M. SAXBY (Hawkes Bay, N.Z.) Second Prizes : Section A, T. DE SOUZA (Colombo, Ceylon) ; Section B, I. W. PEDDER (Sydney, N.S.W.) Consolation Prizes : W. M. FLANDERKE (Colombo, Ceylon) ; J. A. NIXON (Johannesburg, S.A.)

first been elected President. After deprecating his own qualities and powers he appeals "to that Almighty Being Who rules over the universe" for His guidance and assistance in governing the country. Then occur the following fine phrases: ". . . there is no truth more thoroughly established than that there exists, in the economy and course of nature, an indissoluble union between virtue and happiness—between duty and advantage—between the genuine maxims of an honest and magnanimous policy and the solid rewards of public prosperity and felicity . . . the propitious smiles of heaven can never be expected on a nation that disregards the eternal rules of order and right which heaven itself has ordained. . . ."

Later in the same speech he shows how genuinely he is anxious for the prosperity of the country. "When I was first honoured with a call into the service of my country" (that is, when he was first appointed commander-in-chief of the army) ". . . the light in which I contemplated my duty required that I should renounce every pecuniary compensation. From this resolution I have in no instance departed. And being still under the impression that produced it, I must decline, as inapplicable to myself, any share in the personal emoluments which may be indispensably included in a permanent provision for the executive department; and must accordingly pray that the pecuniary estimates for the station in which I am placed may, during my continuation in it, be limited to such actual expenditures as the public good may be thought to require . . ." During the whole of his office, Washington kept to this noble resolution and only accepted payment for his actual expenses.

These two quotations from the inaugural speech serve also to illustrate his ability to construct a speech, although to our modern ideas some of the words may seem to be unnecessarily long.

When Washington was elected for the first time in 1789 there were less than four million inhabitants in the United States, and of these more than half a million were slaves. The census of 1920 shows that the population in that year was near 106 millions, none of whom, of course, were slaves. New York City in 1789 housed 33,000; in 1921, 5,620,000. In 1789 the exports of the country were valued at 20 million dollars and the imports at 23 millions; in 1921 the two corresponding figures were 8,228 millions and 5,278 millions respectively. The signs of growth shown by these figures need no emphasis.

Washington undoubtedly was the man above all others that enabled the country to succeed in its endeavour to become independent, and, when independent, to become prosperous. His life we described last month. But there were other men, however, without whose aid perhaps even Washington could not have "won through," and we illustrate two of them:—Benjamin Franklin and Thomas Jefferson.

Benjamin Franklin, Statesman and Scientist

Benjamin Franklin was born at Boston on the 17th January 1706, and died in 1790 in Philadelphia which was then his home. He was a tall, well-built man and possessed splendid health throughout his life. He was intended to be a clergyman but for some reason or other this did not come about and when he was thirteen (quite a mature age in those days!) he was apprenticed to a printer. He remained in this business for some time, several years being spent in England. He then became clerk to the General Assembly, this being in 1736, and in addition took part in a multitude of public affairs. He was the postmaster of Philadelphia; organised the police force; wrote books and pamphlets; founded a society that eventually became the University of Philadelphia; founded the American Philosophical Society; organised a force of militia; advocated that streets be paved and that they should be better lighted; assisted in founding a city hospital—and so on almost without end.

He took part in various political negotiations in England with great success and in 1762 returned to America hoping to devote the remainder of his life to a study of physics, for Franklin was a scientist as well as a statesman. This was not to be, however, and soon he returned to England sent from America to deal with the disputes concerning the Stamp Act and the tax on imports. He was an ardent peacemaker and did much good work in trying to prevent any serious rupture from England. He was, as we already know, unsuccessful and eventually he came to the conclusion that only independence could be satisfactory to the American people.

He left England in 1775 and found fighting in progress in America. He now became a keen advocate of independence and assisted greatly in obtaining it.

The war being over he was sent to France as a negotiator for assistance and when he arrived there he found himself already the most talked of man in the world. In his negotiations he was entirely successful.

He was truly one of the founders of the United States, but he was never President.

We illustrate here five stamps showing Franklin's likeness. They are:—1851 one cent, 1887 one cent, 1894 one cent, 1902 one cent, and 1923 one cent. He has been used as the subject of several other portrait stamps of the United States but these are a representative selection. It should be noticed that his head is used mainly for the very low values, the object being to secure as wide a circulation as possible for his portrait. To collectors who are not very familiar with his profile, there is often found a difficulty in distinguishing him from Washington. Although the profiles are different, the easiest way to distinguish between them is perhaps by their collars, which are quite different from one another.

Thomas Jefferson, the Democrat

We illustrate three stamps showing Jefferson, the 10 cents value of 1870, the 2 cents value of the 1904 series commemorating the Louisiana Purchase, the crown of Jefferson's career, and the 9 cents of the current series.

Born in the state of Virginia on the 13th April 1743, Thomas Jefferson proved himself an exceptional scholar at college. When he left it at the age of twenty he knew three foreign languages (and he soon learned three more) and possessed a considerable knowledge of science and mathematics which in those days was most remarkable.

He was six feet in height, had rather angular features, never smoked, played cards, nor gambled and was never known to quarrel with anyone on a personal matter. He did not like entering into debate for he believed, probably rightly, that no man was ever convinced by argument, but that reflection, reading and quiet conversation were the necessities.

He was trained to be a lawyer and his brilliance enabled him to pass the highest examinations. He soon gave up his practice however and entered the more congenial realm of politics.

He was a very skilful writer and this fact together with a pamphlet he had written entitled "A Summary View of the Rights of America" largely assisted in his being chosen as the author of the Declaration of Independence, as we have already stated.

In 1779, he became governor of Virginia. Four years later he was back in Congress and he there fulfilled many important offices and produced many valuable documents. Later he became the U.S. Minister to France, but in a few years he returned to America, when Washington, then President, appointed him Secretary of State in the new government. In this office he handled several very difficult French questions with great skill but in 1793 he resigned and his resignation was very reluctantly accepted by Washington.

He retired to his farms and for three years he succeeded in keeping out of political life, but in 1796 he was back again when he was elected vice-President at the same time as John Adams was elected the second President.

Jefferson

At the following election he and Aaron Burr received equal numbers of votes from the Senate for the Presidency and it rested with the House of Representatives to decide which of the two should be President and which vice-President. Jefferson obtained the majority and so became the President. He was re-elected when the time came for him to retire. so that he held this high position for eight years, that is, until 1809, when he refused to be elected again, following Washington's precedent.

His policy was essentially democratic. He would take no notice of titles, refused to allow brilliant dress uniforms, would not allow state balls on his birthday, as was the custom, and, in g eneral, he sought to remove all display and to treat the poorest inhabitant of the country as though he were the highest.

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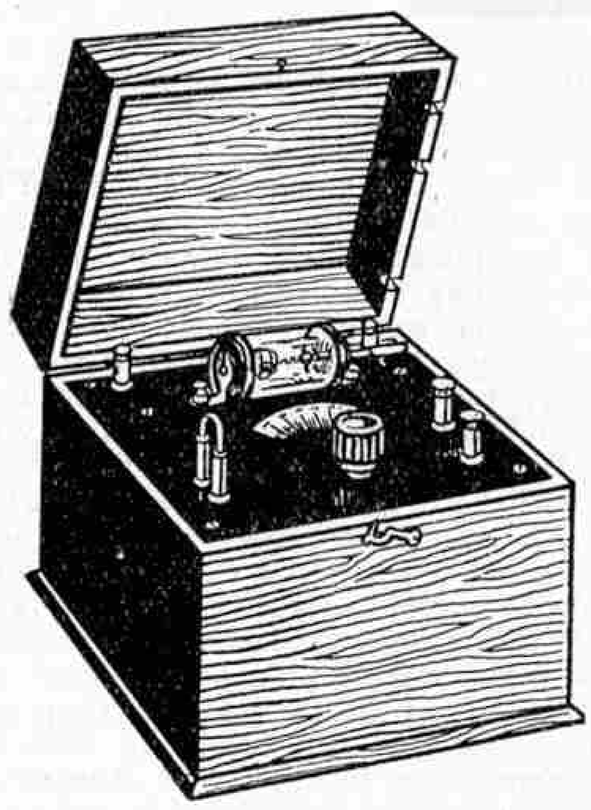

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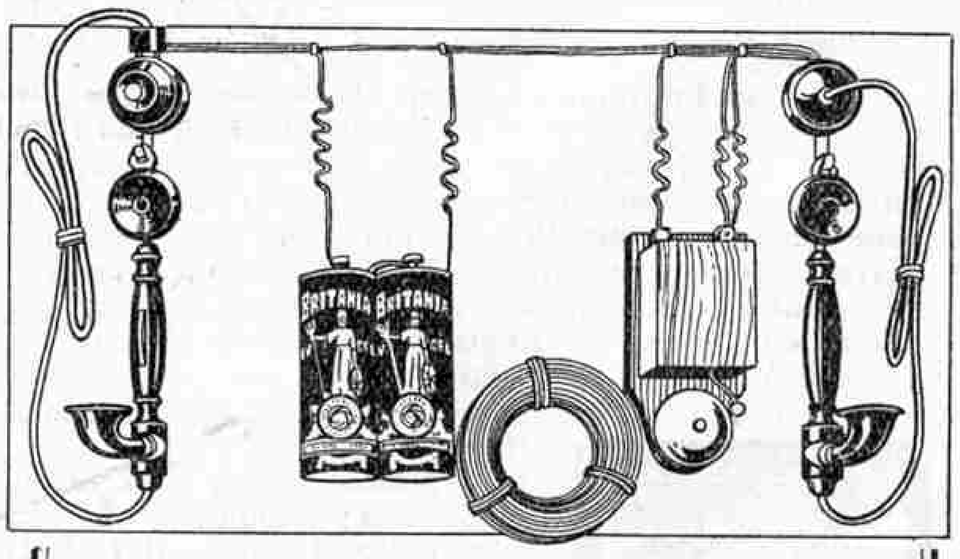

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Have You Sharp Eyes?

Fifth Stamp Competition

THE stamp article published in the June, 1926, issue of the "*M.M.*," illustrating and describing a number of pairs of stamps that are only slightly different from one another, proved so popular that we are introducing the same idea into this month's stamp competition.

Illustrated on this page are two stamps of Ceylon and four of Norway. The two Ceylon stamps and the four of Norway are very like one another but there are differences, and competitors are required to find out as many of these differences as possible and describe them clearly and briefly.

The usual prizes of stamps to the value of £1-1s.-0d., 10/6 and 5/–, chosen from advertisements in this month's "*M.M.*," will be awarded respectively to the senders of the three lists showing the greatest number of differences most clearly arranged.

The closing date is 31st March. Entries should be written on one side of the paper only and should contain, in addition to the lists of differences, the competitor's name and address, and a list of the stamps he wishes to be sent to him if he should win a prize.

The differences between the stamps may be discovered by examining the illustrations on this page or, preferably, by examining the stamps themselves if they are included in your collection. The stamps are described in the catalogues as being: Ceylon King George V. head, Dies I and II, these two particular stamps being first issued between 1922 and 1925. The Norway stamps are as follows: No. 3:—1871, No. 4:—1877, No. 5:—1882, No. 6:—1893.

In describing the differences make use of these four abbreviations in referring to the four corners of the stamps:—" TL " = top left-hand corner, " TR " top right-hand corner, " BL " bottom left-hand corner, and " BR " bottom right-hand corner. In referring to different parts of the stamps use the abbreviations " R " for right and " L " for left whenever you use these words, but do not use any other abbreviations in your descriptions.

Describe each difference you can find and when you have finished count the number you have located and write this number at the foot of your list.

In the four stamps of Norway do not take any notice of the different values illustrated on the stamps nor of the different coinage indicated on the first stamp. In addition to finding points in which all four stamps differ from one another, those should be found also in which three of them are different and those in which only two differ. For example, you may consider that the word " Norge " is the same on stamps 3, 4 and 5, but different on stamp 6.

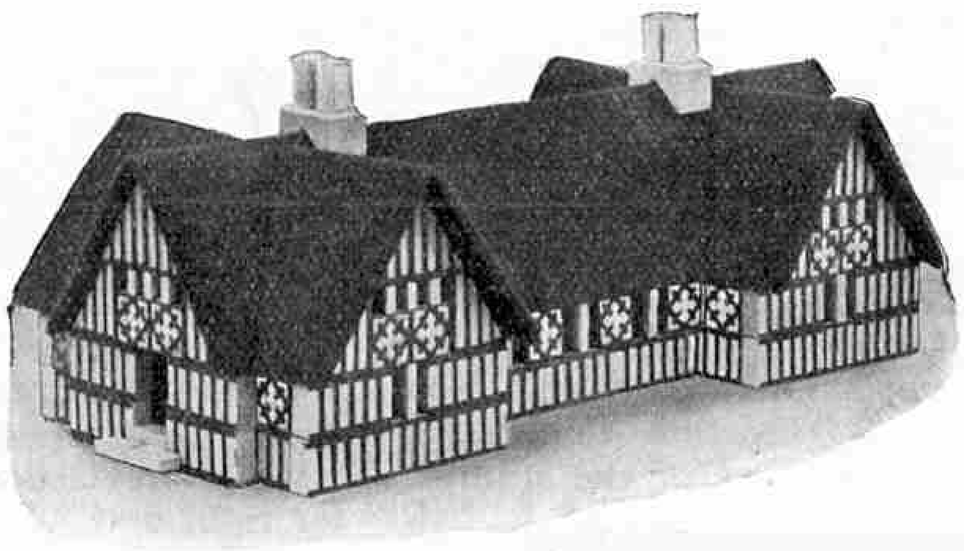
Collectors are often puzzled to account for these minute differences that occur on stamps. They are, of course, quite different from flaws that occur on perhaps only one particular copy of a stamp, for these differences are the same in every stamp of the sheet. All stamps printed before a particular date are usually alike, and those printed after it are like one another but unlike all those previously printed.

For example, in the case of the Norway stamps illustrated, all issued between 1871 and 1877 were like No. 3, all between 1877 and 1882 were like No. 4, and so on. These differences are due in every case to either a new or a retouched die. From the single die are made all the impressions on the printing plate by means of a process of transference as was described in the August 1924 issue of the "*M.M.*" (p. 225).

No. 1 No. 2

No. 3 No. 4

No. 5 No. 6



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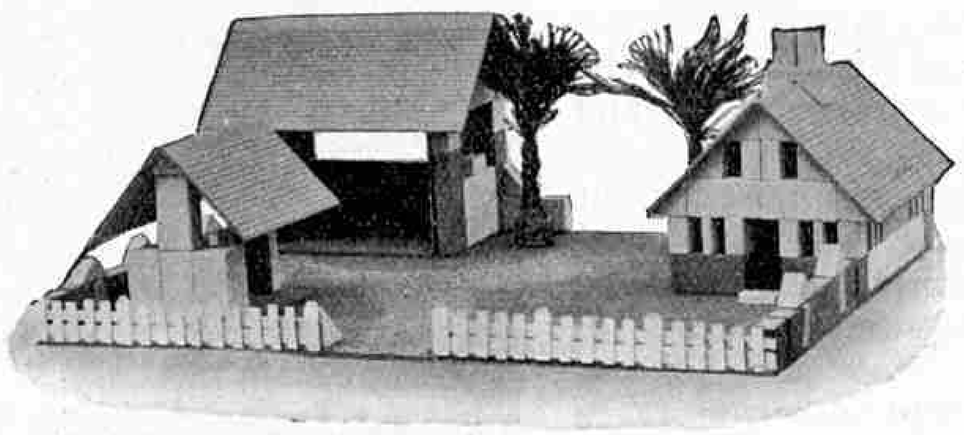

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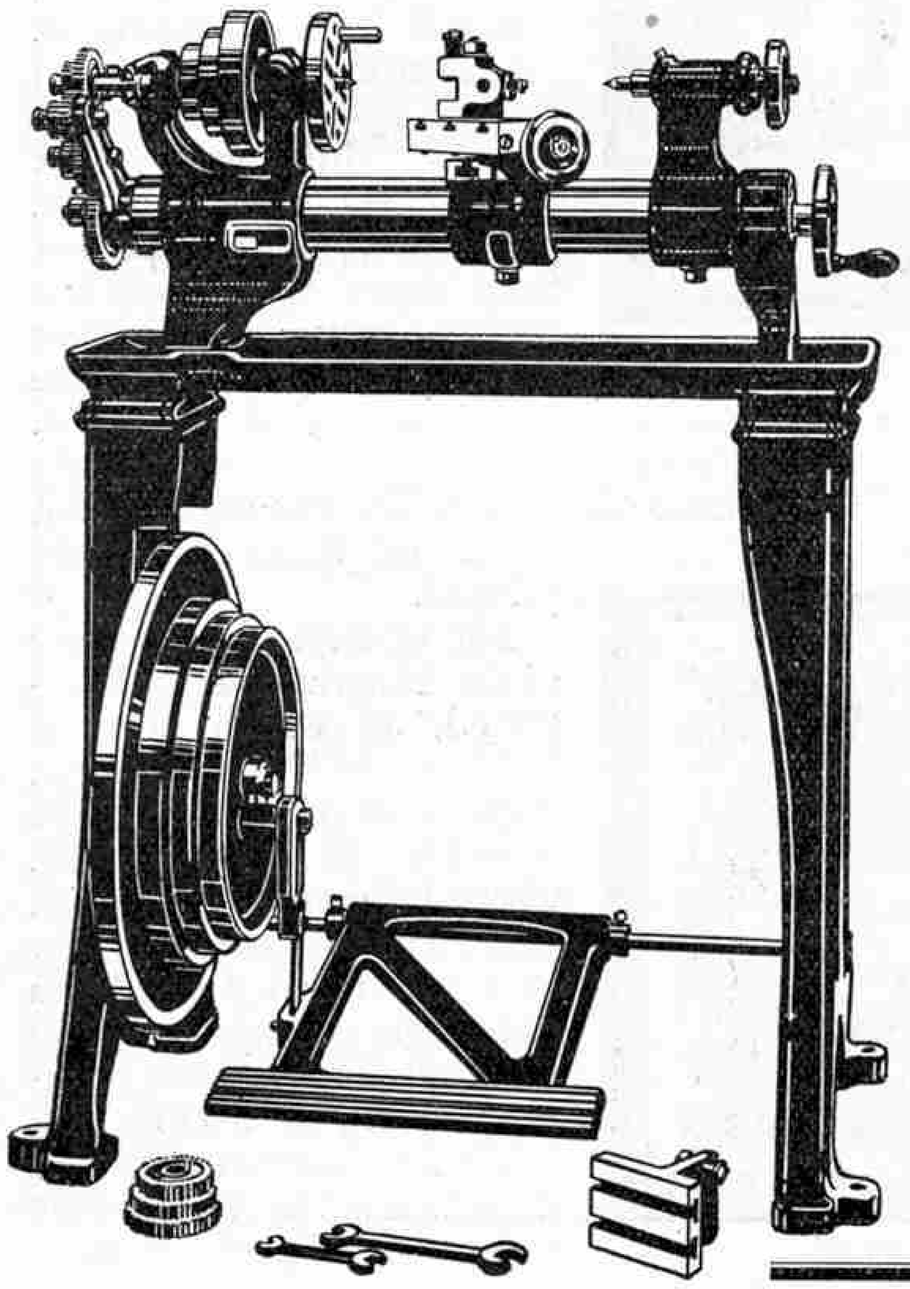

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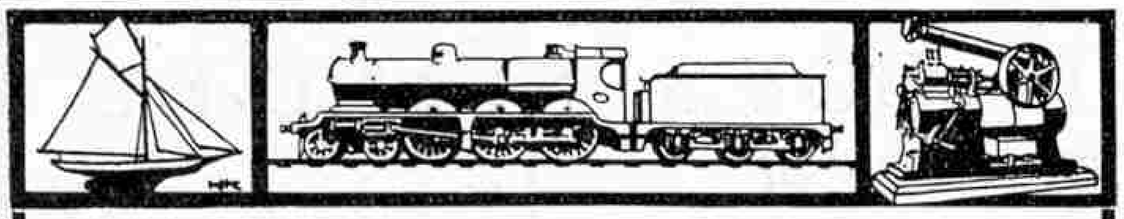

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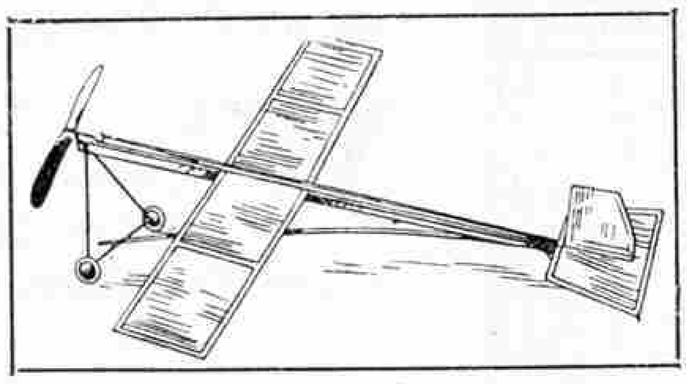

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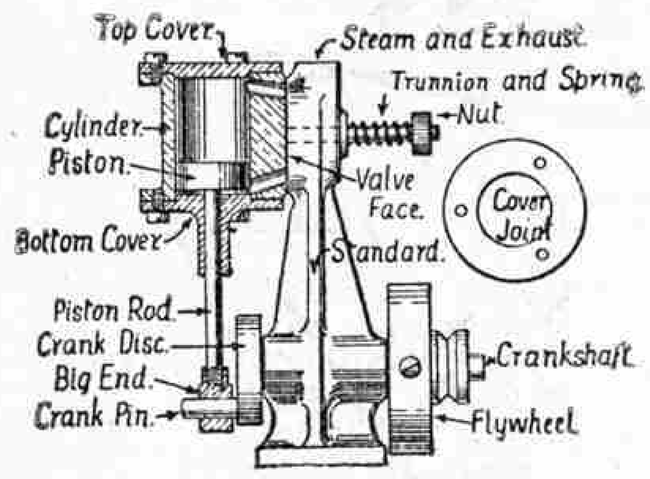

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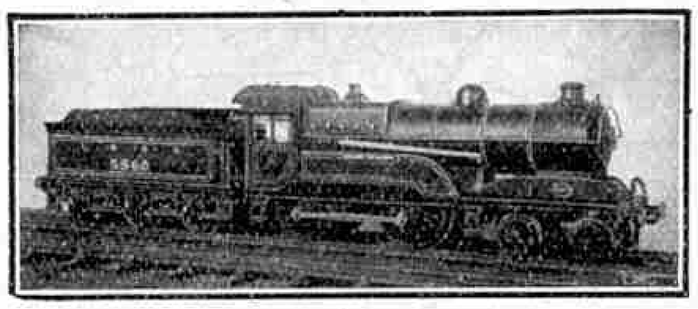

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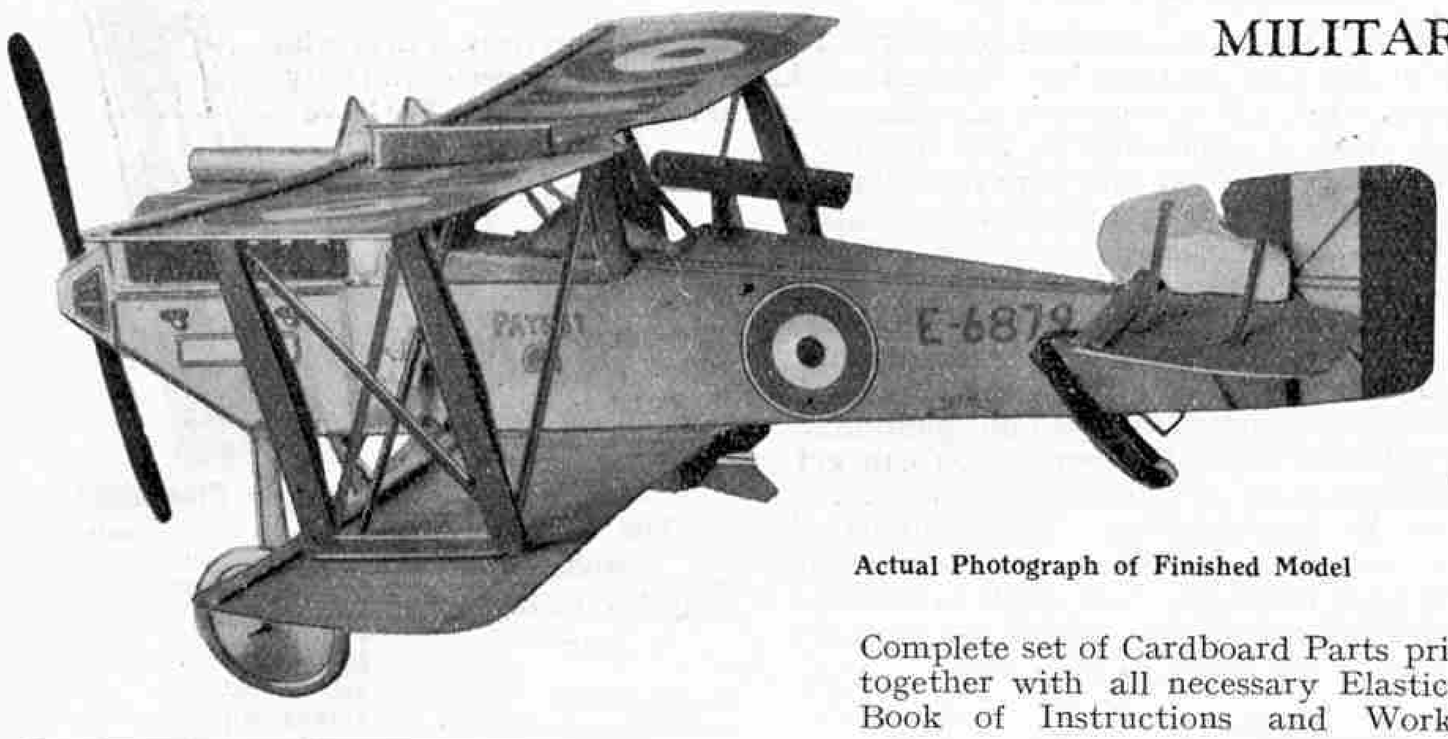

Actual Photograph of Finished Model

MILITARY BIPLANE, TYPE E-6879

SPAN 12 ins.

THE very thing for dark evenings. The model has all the parts and controls that you'll find on the big planes. Elevators, ailerons, machine guns, pitot tubes, windscreens, and even a miniature dashboard with dummy instruments, gauges, etc. Real elastic shock absorbers are fitted to the landing wheels and tail skid. When you have built up the model you can make it do everything that a real plane can do.

Size of model: Span 12 ins., Length 13 ins.

Complete set of Cardboard Parts printed in colours, together with all necessary Elastic, Wood, Wire, Book of Instructions and Working Drawings.

Price 1/- Post 4d. extra

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SPAN 21 ins.

A MODEL of the remarkable Beardmore light monoplane which took part in the Air Ministry trials at Lympne. The original is fitted with a Bristol "Cherub" two-cylinder air-cooled engine. The model is a splendid flier and looks very neat.

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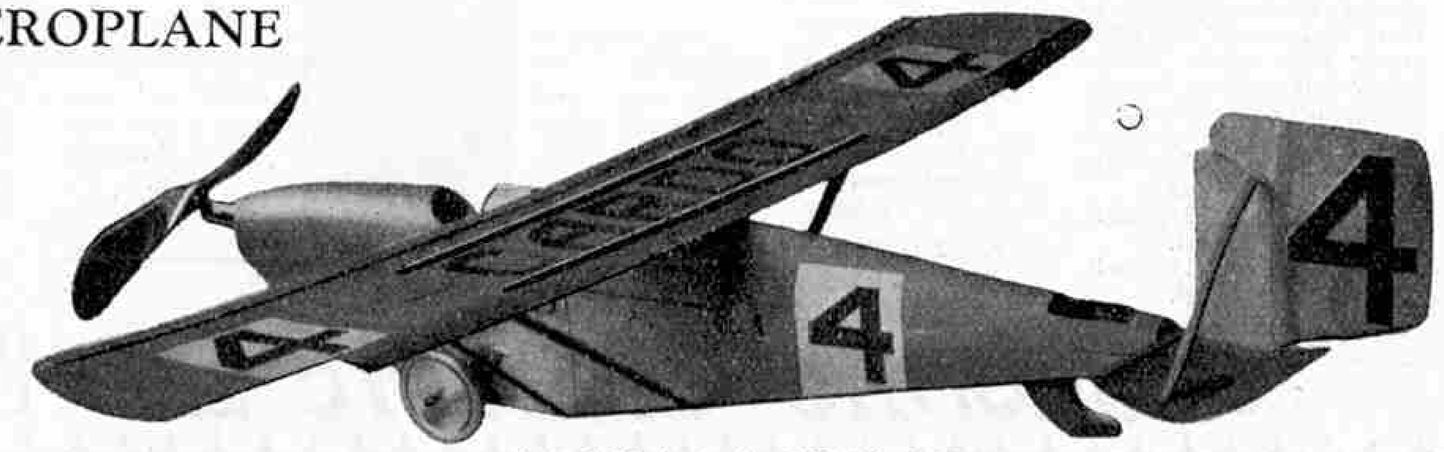
Construction.—Patent hollow spar construction with wooden struts.

Chassis.—The metal disc wheels and axle of the under-carriage are sprung with elastic shock absorbers.



Actual Photograph of Finished Model

Complete set of Cardboard Parts, printed in colours, together with all necessary Elastic, Wire, Wooden Spars, Satin Walnut Propeller Blank, Wheels, Book of Instructions and Working Drawings. Packed in an attractive box.

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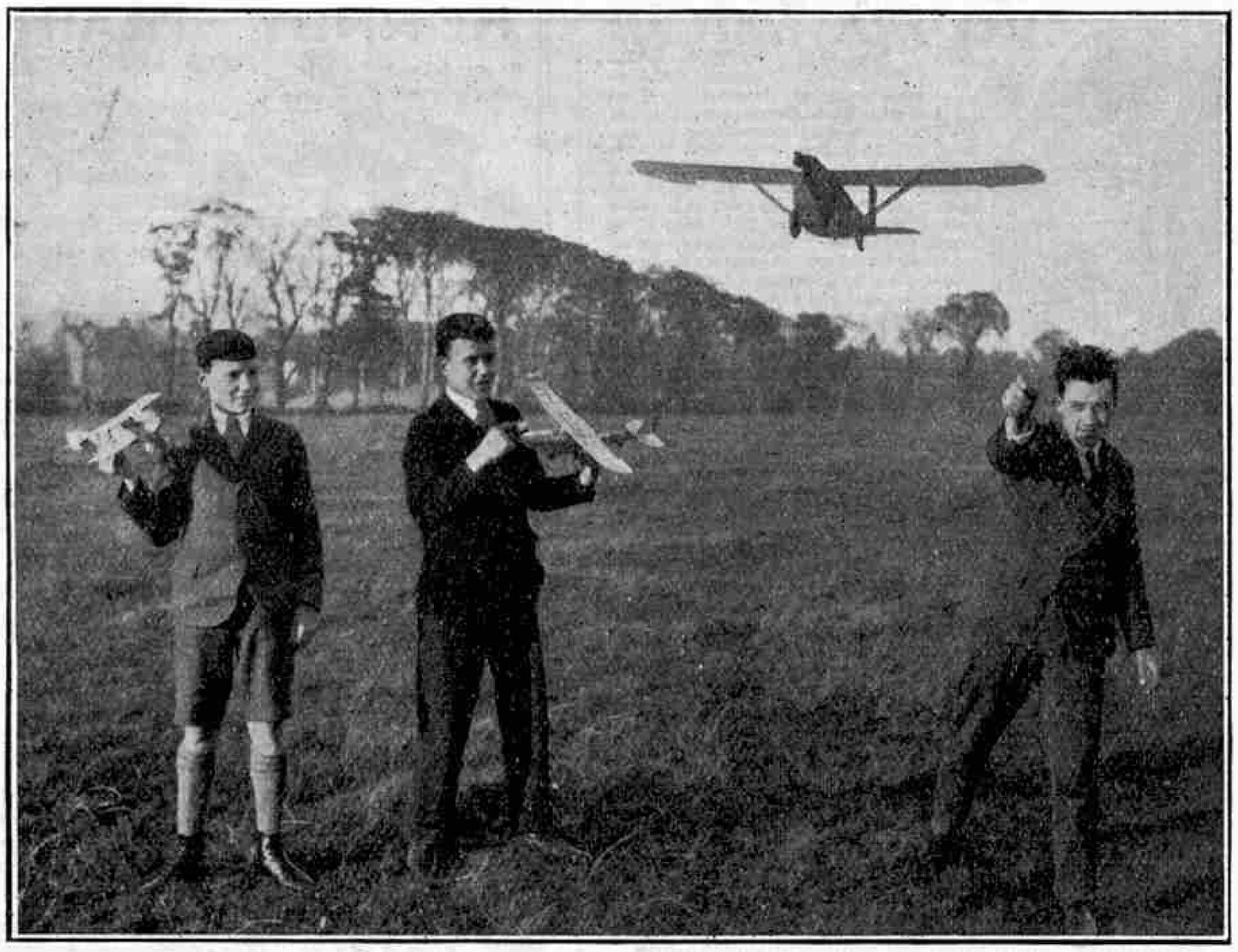

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Dear Sir, Received two Biplanes and I was highly satisfied.—Yours sincerely, Edulji Bomji, Suklua, Byculla, Bombay, India.

Dear Sir, I received your model Aeroplane quite safely. The first day I tried it, it simply glided down and alighted safely on the floor. I am enclosing a photo of myself and the aeroplane.—Yours truly, George F. Clark, Bez Valley, Johannesburg, Transvaal, S. Africa.

Dear Sirs, I received your Wee Bee I. and I am extremely pleased with its performances. It is the best flyer I have come across, although I belong to a Model Aero club. Yours truly, F. Y. Wittingham, Gloucester.

Dear Sir, Will you kindly forward Military Biplane. The last one I had was a beauty, absolutely real in every detail.—Yours sincerely, James E. Shapley, Exmouth, S. Devon.

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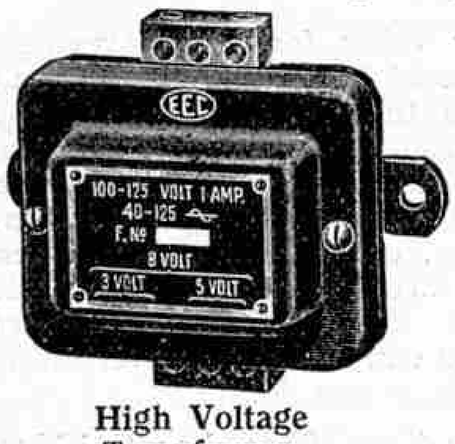

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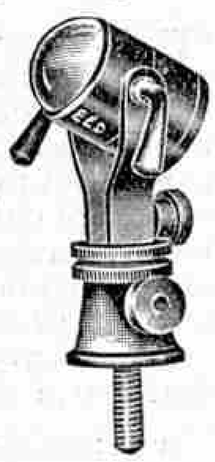

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Throws a brilliant beam of light. Double movement enabling beam to be focussed in any direction.

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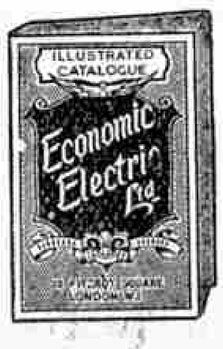
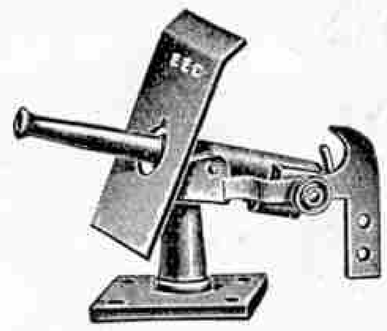


Don't hesitate to write to us if this Catalogue does not contain exactly what you want.



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A wonderfully ingenious piece of mechanism. This model is built on really scientific lines and enables a remarkable degree of accuracy to be attained. No model fortification is complete without this E. E. C. Quick-Firing Gun.

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and go care - free on your way. Tubes treated with our IMPERVO increase the joys of your Cycle.

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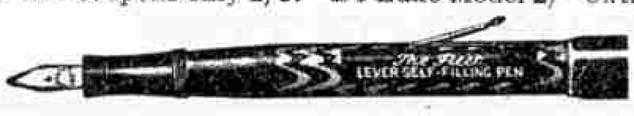

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Lady's or Gent's model same price, Carriage Paid Terms: **8/-** now, & **8/-** monthly. Complete Approval

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build a working model railway, realistic in appearance and efficient in operation, by using

HORNBY TRAINS

We carry full stocks. Ask to see samples.

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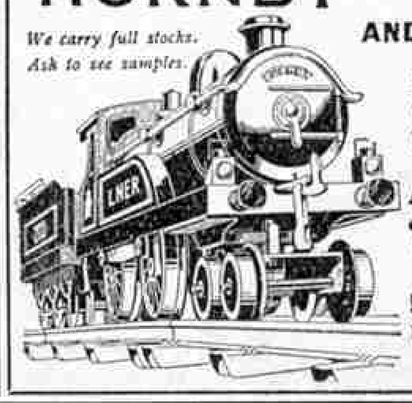

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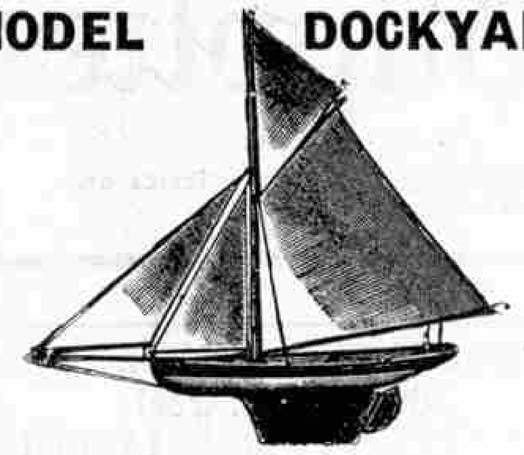

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1000's SOLD | 1/3 POST FREE | POCKET SIZE
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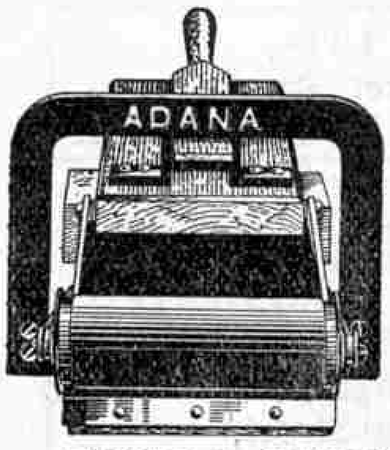

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Have proved their superiority in Model Flying Competitions. They have gained more awards than any other make of Model Aeroplane, and are holders of Official British Flying Records.
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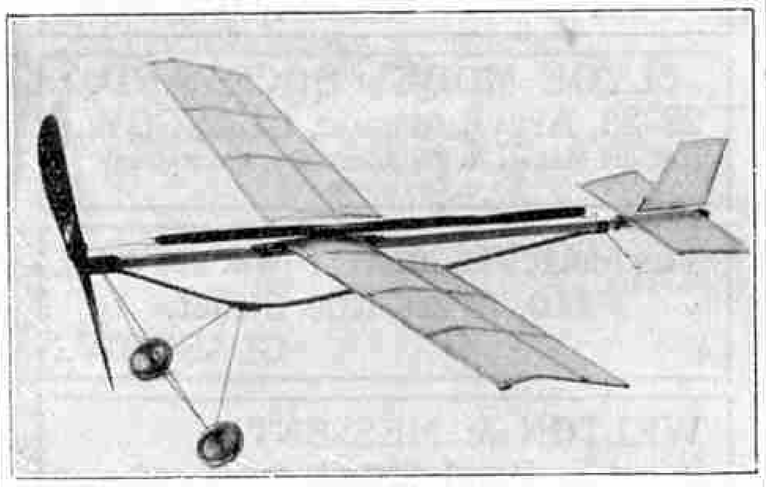

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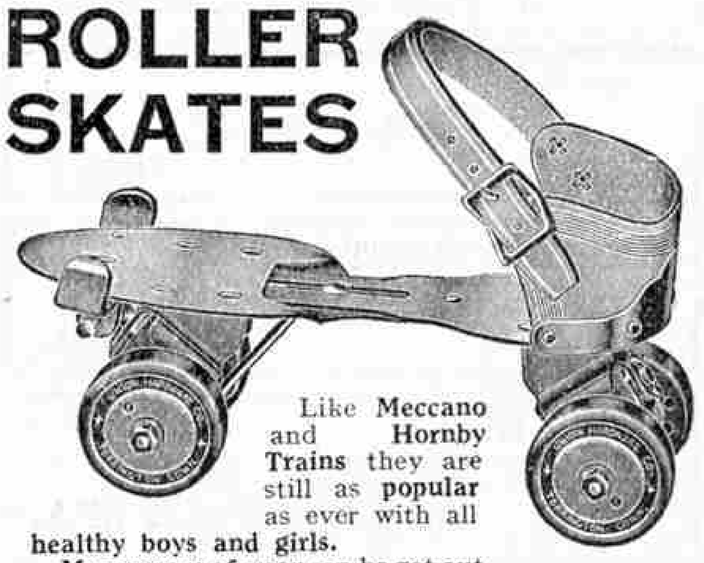

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DIBBS' DOLLIES' HOSPITAL,
NELSON, LANCS.

Meccano & Hornby Train Supplies

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Mechanical Parts of a 1st-class
RIFANCO PHONE
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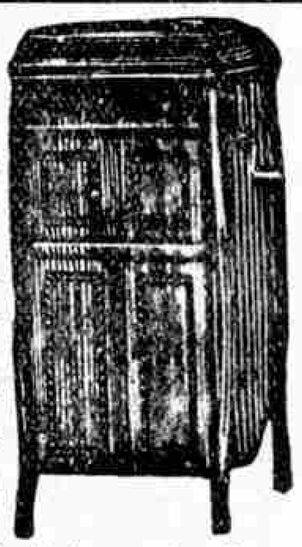

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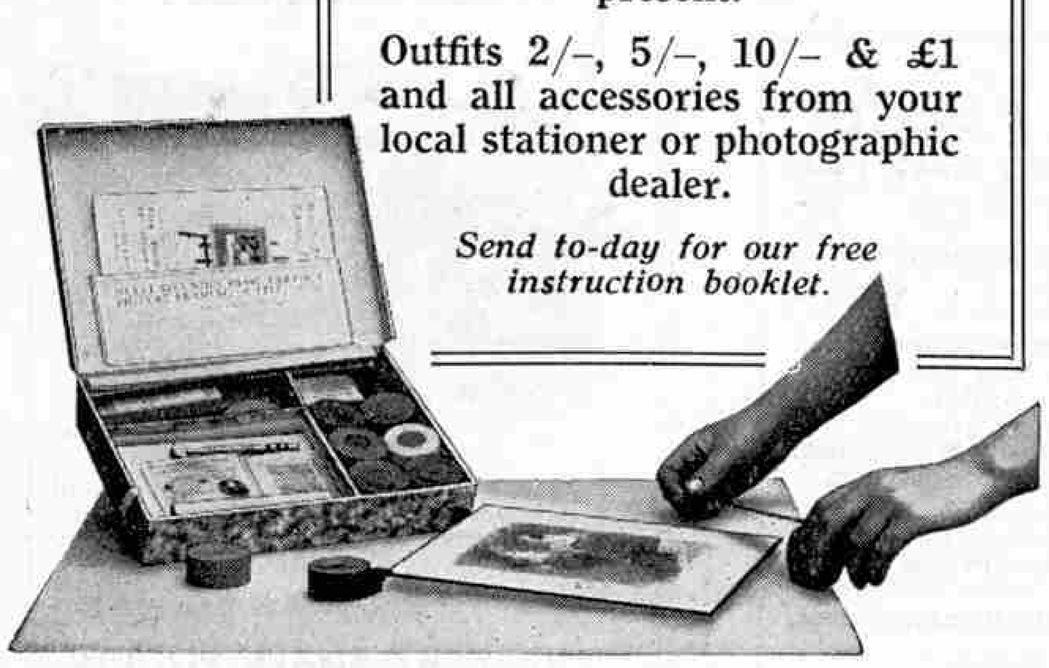

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Wanted back numbers of the "Meccano Magazine" up to January, 1921, at 6d. each.—Box 301.

Wanted. Birds' Eggs. Sale. Cigarette Cards, Albums, Clockwork Guage 0 Train Set, Camera, Air-gun, Yacht, 96 Weekly "Chums."—Wood, 17, Blundell Avenue, Cleethorpes, Lincs.

Miniature Electric Table Railway. 11 Straights, 22 curves, regulating rail, crossing, points, 3 passenger coaches, 3 covered wagons, 1 open, also 1 clockwork loco. 15/- or offer.—BM/GARG, London, W.C.1.

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For Sale. 3,500 Tram and Omnibus Tickets. Quite clean. Cheap. Anybody wishing to buy these or any number of them should write to—B. A. Shattock, St. Mark's Vicarage, Peak's Hill, Purley, Surrey.

Wanted. "Meccano Magazine," September 1925. Will give 2/6 for clean copy. Write—A. Hill, Greenham Street, Cottesloe, W. Australia.

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For Sale. One Cameo Camera, for plates and film packs. Size ¼-plate. Almost New. What offers?—Doupe, Tramore, Co. Waterford.

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Sale. Boy's Own Paper, Vols. 43-47, 4/- each. Good condition.—Witham, High Street, Abingdon, Berks.

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Vertical Steam Engine, Siren, Regulator, Gauge, New, 12/6.—Cigarette Cards, 6d. 100.—Box No. 307.

Miniature Table Railway, cost 14/-. Vertical Steam Engine, cost 3/6. Electric Motor, cost 5/-. All in good working order. Exchange lot for a good Camera.—Lambert, 4, Fixby Avenue, Pye Nest, Halifax.

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EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept any responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (*i.e.*, not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper.

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order.

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

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Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office, the price and subscription rates being as above.

IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Messrs. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), Textile House, Von Brandis St., Johannesburg.

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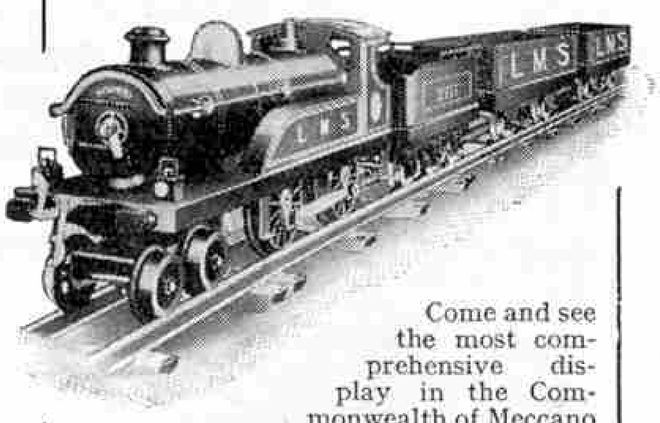

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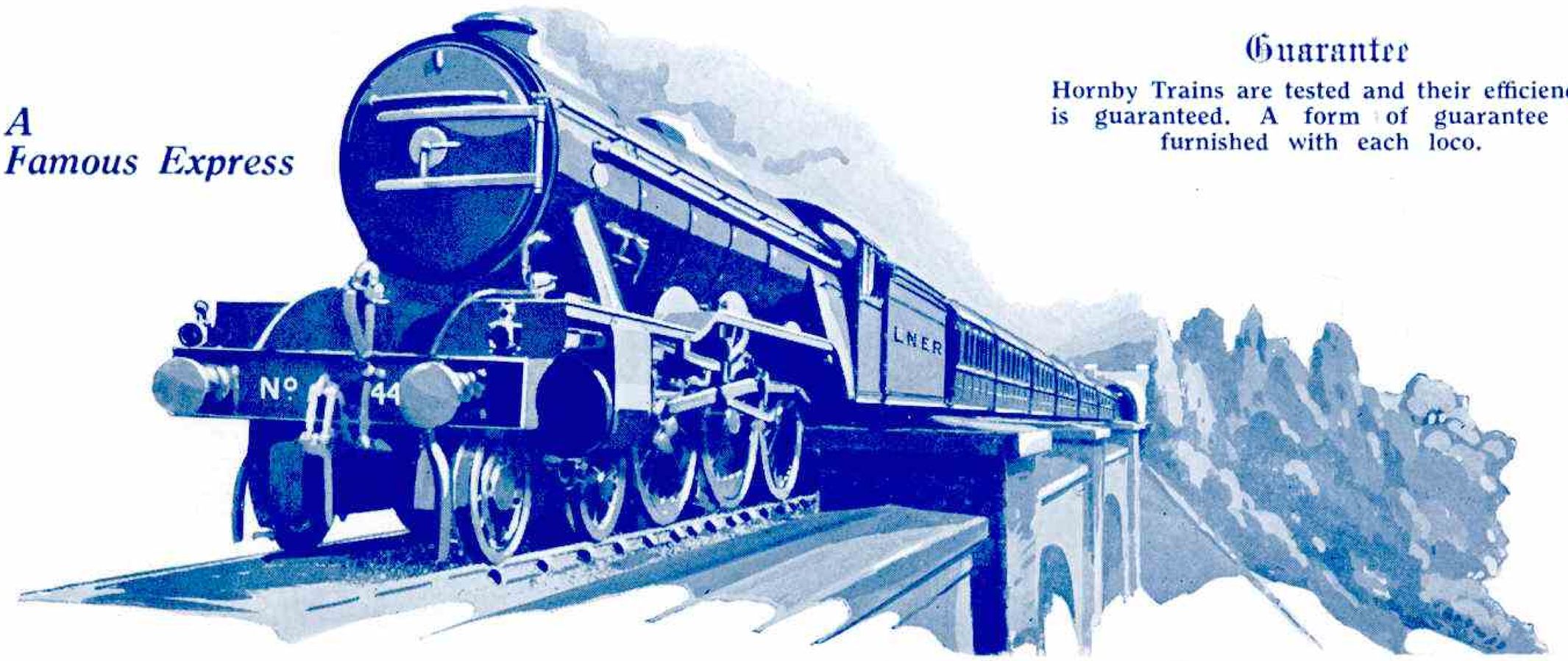

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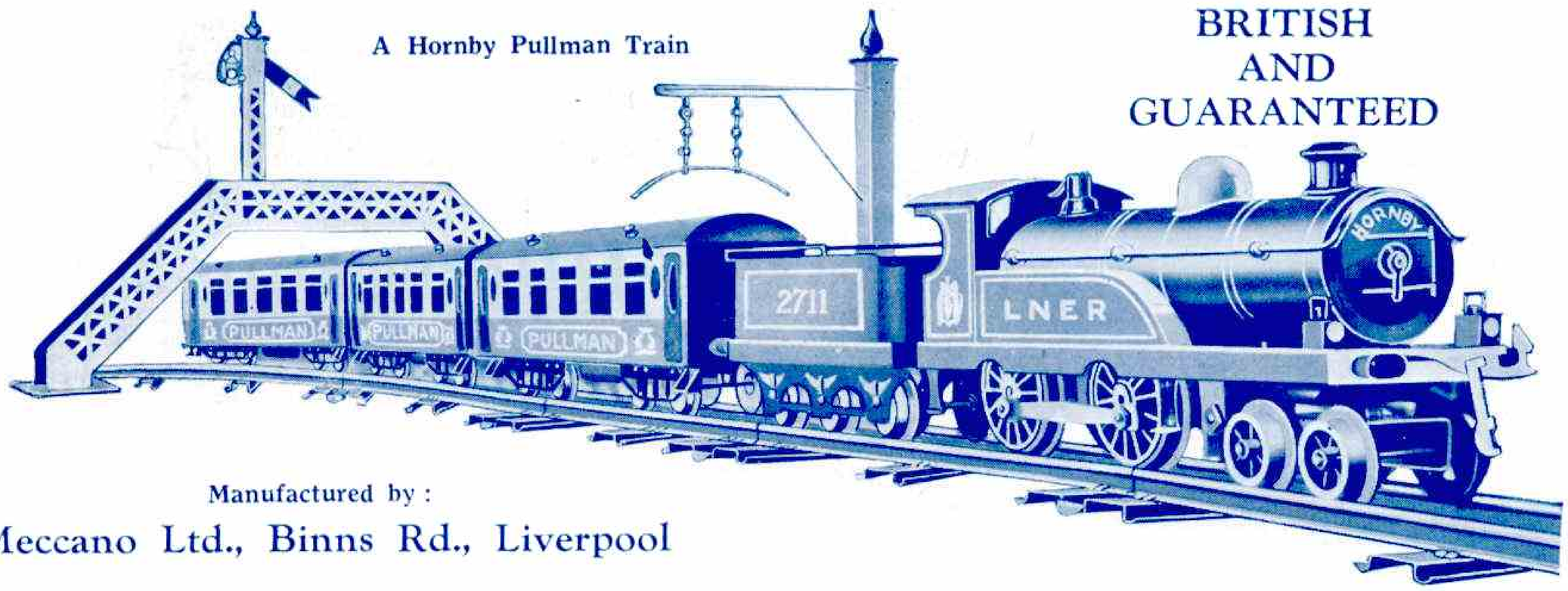

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